A Theory of Society Derived from the Principles of Systems, Psychology, Ecology, & Evolution.

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1. Introduction

The lack of a unified theory of human society is hampering our ability to tackle the self-induced existential threats that we currently face. This paper presents a practical social systems theory that addresses that absence. Furthermore, because the theory has been derived largely from the principles of systems science, ecology, and evolution, it has a broader application to natural ecosystems, artificial ones, and the interactions between them and the human species. The theory draws on an empirical observation of society; the principles of systems science to describe the general structure of society; on the principles of ecology to describe the ways in which two components of society can interact; and on the principles of psychology and evolution to demonstrate how those interactions can alter with time. The principles employed are fundamental to the field from which they were derived, are broadly accepted by practitioners in those fields, and were obtained by research of the literature. What is new, in this paper, is the combined application of principles from these different fields to human society. The result is a model that accurately reflects real situations involving social units of all sizes from individuals, through organisations, to nations. Methods are suggested for symbolising, diagramming, and analysing these interactions and how they change over time. This provides a basis for better understanding the causes of the threats that humanity and the natural world faces, and for designing interventions to counter them. This paper is targeted at a broad audience which may include specialists from various disciplines. Interpretation of the language used and the concepts that underpin this theory may differ from individual to individual and from discipline to discipline. No prior knowledge is assumed, therefore. Furthermore, the paper is written in plain English and, where any technical terms have been used, they are clearly defined.

A. The purpose of social systems theory

In his 1980 paper "A Confluence of Feedback Loops in Social and Educational Structure: (in the context of developed and developing countries)", M. M. Gupta of the Systems Science Research Laboratory, University of Saskatchewan, Canada, stated the following.

"In the case of inanimated physical systems, it is a well-known empirical fact that unrestrained increase in the degree of positive feedback between the various components of a system leads to instability, oscillations, and eventually to a failure. There is a warning in this that cannot be ignored: Our socio-economic systems, too, are likely to face an eventual catastrophic failure if the growth in the degree of interdependence within them is not accompanied by better planning, coordination, and - what might be much less palatable - restraints on our freedom… In fact, in some of the advanced societies of so-called developed countries, with libertarian traditions – in which there is an understandable aversion to planning and control - our society is already witnessing the manifestations of what might be diagnosed as the 'crisis of undercoordination': vehicular and air traffic congestion, deterioration in the quality of municipal services, decay of urban centers, power blackouts, air, water and other environmental pollution, shortage of energy, unemployment, strikes, inflation, recession and depression, wars, depletion of earth's non-renewable resources, and political and other economic crisis, etc. And there may well be the precursors of far more serious stresses and strains which lie ahead - stresses which may test to the limit the endurance of our democratic institutions - both in the developing and the developed countries." (Gupta, 1980)

The solution that Gupta offered lies in Social Systems Theory. This concept has two aspects. Firstly, Social Systems Science, whose aim is to identify and understand the processes at work in society, i.e., why do we behave as we do? Secondly, Gupta uses the term Social Systems Engineering to describe the practical modification of existing feedback loops and other forms of causality to achieve a stated objective. That is, how to do what needs to be done for us to behave in a more sustainable, socially friendly, and environmentally friendly way.

The term, 'Social Systems Engineering', was coined in the 1970s and suggests that society should be steered in a mechanistic way by technocrats aloof from the rest of society. This is not possible or desirable. We are all subject to the same virtues and shortcomings, albeit in varying degrees, and the ideal technocratic leader does not exist.

It is also important to be aware that Social Systems Engineering can also be used to satisfy the needs of one group to the detriment of another. Its objectives should, therefore, be ethical and aim for improvements in the wellbeing of the natural environment and all of humanity.

So, in practice, the rational approach to steering society needs to be built into our democratic processes, rather than entrusted to the hands of a few. A better term might therefore, be 'rational and informed democratic intervention'.

In his paper, Gupta concludes that "The strength of social systems engineering [or rational and informed democratic intervention] lies in its willingness to confront the basic issues and problems in the present day setup of socio-economic systems, and its boldness to borrow and integrate ideas and methodologies from the disciplines such as humanities and social sciences. We need system engineering, social scientists, and economists to spend more and more of their cooperative efforts in this direction. It can make a pragmatic contribution if we can bring a stability to our socio-economic system." (Gupta, 1980)

Additionally, however, to fully understand our social processes, we also need to consider the evolutionary and ecological principles that have formed them.

Gupta's paper was written in 1979, during a period of trade union unrest. However, times have moved on. Rightly or wrongly, neo-liberalism has reduced the power of trade unions, and we currently face a new set of difficulties. Nevertheless, his recommendations remain relevant, albeit in a different context. So, in this paper a social systems theory is developed whose purpose is to enable us to understand why society is where it is, where it is heading, and what we should do to steer it on a more favorable course.

B. The principles of social systems theory

The social systems theory described here is based on the ten principles listed below. Each principle is outlined in this section and is discussed in more detail in the sections that follow. A series of laws are derived from these principles and are listed in the appendices. Where one is encountered in the text, its reference is given in brackets.

Principle 1: Cognitive physicalist philosophy. The cognitive component of this philosophy holds that the universe is infinitely complex, but our minds are finite. So, to understand the universe we must mentally represent it in a simplified way. The physicalist component of this philosophy holds that everything is physical in nature, i.e., everything exists within space-time. (Challoner 2023).

Principle 2: Human holons. This principle is derived from systems science. The fundamental component of society is any individual person, any group of people, or any group of groups who work together with a common purpose. Because we give many names to such groups, e.g., individuals, clubs, charities, organisations, sectors, nations, groups of nations, and humanity as a whole, the term "human holon" is used to describe any one.

In systems science holons form a nested hierarchy and the same is true of human ones. For example: at the lowest level there may be several individuals; at a higher level they may form an organisation; at a yet higher level several organisations may form a nation; and at the highest level several nations form humanity. (Law B04)

Principle 3: Control components. This principle is also derived from systems science. Every human holon has, using the terminology of systems theory, a control component. In more common language this is a manager or leader. Its purpose is to co-ordinate the activities of other components of the holon or, again in more common language, team members. Because human holons form a nested hierarchy (Law B04), these control components also form a hierarchy (Law B05).

Principle 4: Needs. This principle is derived from psychology. All human holons have the same range of needs. These form a hierarchy with existence needs at the lowest level, relatedness needs at the next level, and growth needs at the highest level. All human holons prioritise their needs in that order (Law F01).

Principle 5: The Nature of interactions. This principle is derived from economics. Satisfiers are those external things that increase the level of satisfaction of a human holon's needs. A contra-satisfier is a term coined by the author and reduces their level of satisfaction. Satisfiers and contra-satisfiers can comprise space, matter, energy, or information. Money is information and property that acts as a satisfier to the recipient and as a contra-satisfier to the giver. Interactions between human holons involve the provision of a satisfier or contra-satisfier to the recipient by the supplier. Such interactions are frequently reciprocal, but not necessarily so.

Principle 6: The range of interaction types. This principle is derived from empirical observation. Horizontal interactions are between human holons at the same level in the hierarchy. Vertical interactions are between holons at different levels. The range and types of horizontal interaction are the same at all levels. They are also the same as the range and types of vertical interaction. Thus, the same range of interactions can be found between two individuals, between two organisations, and between an individual and an organisation (Law C01) & (Law C03).

Principle 7: Choosing whether and how to interact. This principle is derived from both psychology and economics. If it has a choice, then before interacting, a human holon will assess the net benefit or disbenefit of the interaction. This comprises any increased satisfaction of its needs provided by satisfiers in the interaction minus any decreased satisfaction resulting from contra-satisfiers. The probabilities of experiencing the relevant satisfiers and contra-satisfiers and the holon's available resources are also factored in. So too is the likely effect on any other social holons to which the first is related, but the weight given to this effect diminishes with the distance of the relationship. In the case of individuals, this assessment is often based on an improvement or a worsening of the holon's emotional state. In the case of higher level holons more objective modelling may be carried out, but not necessarily so.

Principle 8: The social/ecological isomorphism. This principle derives from systems theory. An isomorphism is a similarity of structure that can be found in different types of entity. The social/ecological isomorphism is a recognition that the range and types of social interaction is the same as the range and types of ecological ones. The basis for this isomorphism is that ecology takes the "living holon", i.e., any organism, group of organisms, species, or ecosystem as its fundamental component, social systems theory takes the human holon, and human holons are a subset of living ones. However, because new properties emerge with increasing complexity (Challoner, 2022), it is possible that some human interactions do not occur in other species.

Principle 9: The culture/genome Isomorphism. Again, this concept derives from systems theory. The culture/genome isomorphism applies to information contained in the genome of an organism and its effects. It also applies to information contained in the culture of a society and its effects. Culture comprises norms, values, beliefs, and knowledge, and symbols. An organism's physical manifestation is the result of its genome operating on its environment. Similarly, a human holon's physical manifestation, i.e., society, is the result of its culture operating on its environment.

Principle 10: The cultural evolution/biological evolution isomorphism. Once again, this concept derives from systems theory and applies to the way that both organisms and societies change with time. Living holons change according to evolutionary laws operating on their genome. Human holons change according to the same laws operating on their culture. The latter does however take place at a much faster rate and is less constrained by generational replacement.

2. Principle 1: Cognitive physicalist philosophy

One of the principles of social systems theory is cognitive physicalist philosophy.

The cognitive component of this philosophy holds that the universe is infinitely complex, but our minds are not. Therefore, to understand the universe we are obliged to mentally represent it in a simplified way. One of the ways we do this is by using holons. These are things whose structure we recognise due to its recurrence. Holons enable us to recognise threats and opportunities from experience or from knowledge passed on by others. We respond to holons in a way conducive to our survival and procreation, and so our ability to recognise them has an evolutionary source.

The physicalist component of the philosophy holds that everything is physical. In other words, everything comprises matter or energy in space-time, and there is nothing other than that. If we also accept Einstein's proposition that matter is organised energy, then this simplifies, yet further, to the premise that everything is energy in space-time.

There are two outputs from this philosophy of significance for social systems theory.

Firstly, information is physical in nature. It exists at source, i.e., in the original physical thing that we are thinking of, or communicating about. Information at source is the structure or organisation that we recognise in that thing. Information at source can be translated into a simplified form capable of being held in, and manipulated by, our minds. This simplified form can be an icon or image, or it can be a symbol or word. This icon or symbol is also organised matter or energy that represents a holon in the physical universe. We can also create external representations of internal ones in the form of drawings, words, etc. This enables us to communicate information to others. Both translations are fraught with difficulties, of course, but these will not be discussed here.

Secondly, even abstract things, such as relationships and characteristics, are physical in nature. For example, a characteristic is the aggregate of all physical things that can be said to have it. So, justice, is the aggregate of all just acts. To cite another example, a relationship between two things is the aggregate of those things. It exists only for as long as the characteristic that defines them applies to them. This implies, for example, that co-operation is physical in nature. A relationship does not exist independently of two parties who co-operate. Rather, it IS those two parties for so long as they have the characteristic of cooperating with one another.

3. Principle 2: Human holons

The term holon was coined by Arthur Koestler in his 1967 book, The Ghost in The Machine. (Koestler, 1967). It refers to any entity that can be recognised as a whole in itself and which constitutes part of a larger whole. In social systems theory the fundamental component of society, the human holon, is any individual or group of people who work together with a common purpose. They can be an organisation of any type and can range in size and extent from an individual, through clubs, businesses, sectors, political parties, governments, nations, and groups of nations, to the global community.

The fractal structure of nature was discovered by the French-American mathematician, Benoit Mandelbrot (Mandelbrot, 1982). Eliot Kersgaard defines a fractal as a system with similar properties at all scales (Kersgaard, 2019). Numerical fractals such as the Mandelbrot set or geometrical fractals such as the Sierpinski triangle are well known, and where most fractal research has focused. In these cases, Kersgaard's "scale" is numerical or geometrical. However, these fractals are normally displayed using the two dimensions of a piece of paper or a video screen. So, incorrectly, their scale appears to be spatial. However, scale can also apply in a physical sense to features of reality, such as objects, events, or relationships, in which case scale is genuinely either spatial or spatio-temporal. The leaf of a fern is, for example, a genuine spatial fractal.

The rule that creates a fractal is known as a generator. In the case of the Mandelbrot set, the generator is a simple recursive mathematical formula. The generator for human society is, however, more complex. It is the relationships between human holons at various scales that create society. However, these relationships are not always cooperative ones. If that were the case, then all of humanity would comprise just one organisation with a single leader. This is clearly not the case and, as an alternative therefore, I suggest the rules of interaction described in this paper.

In particular, where there is vertical cooperation between human holons, whether voluntary or involuntary, this creates another at greater scale. Thus, human holons form a nested hierarchy. (Law B04) The structural relationships between them are similar to those in a family and the same names can be used, therefore. Thus, for example, child holons are components of a parent one, and parent holons are components of a grandparent one. Two holons that are components of the same parent are known as sibling holons. This nested hierarchy can continue upwards until the global community is reached. It also continues downwards to individual people.

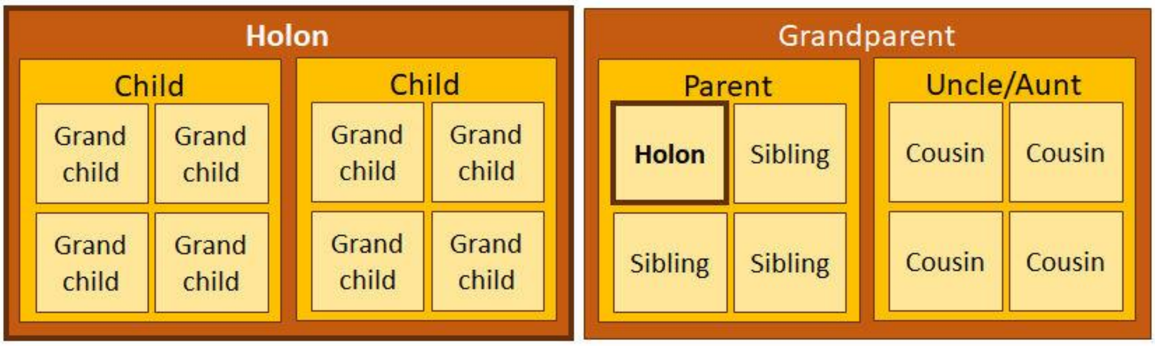


***Figure 1** – Familial relationships in a nested hierarchy of holons.*

4. Principle 3: Control components

The Viable Systems Model (VSM) was proposed by the British psychologist, Stafford Beer, in his 1972 book "The Brain of the Firm" (Beer, 1972). This model is used as a framework for understanding human organisations, but it is also thought to apply more broadly to other animals and groups of animals. In simplified terms, the model proposes that every organisation has a control component that coordinates the activities of other components, e.g., the brain of a human being or the manager of a team or organisation. For a simple explanation of this model refer to (Webpage P).

Beer recognised that his VSM model was recursive, i.e., every model comprised components, one of which was a control component, and every component was a VSM model. However, this was before the fractal structure of nature was discovered. In fact, the VSM model is a fractal generator that applies at all scales of organisation and is comparable therefore to the simple recursive formula used to generate the Mandelbrot Set. Furthermore, control applies to a function, and there are very many functions. This means that the VSM model, or something similar, is likely to apply quite extensively to people and other animals. Choose any "organisation" and function anywhere among people and animals and you are likely to find that VSM applies. There is never just one "controller" therefore. Rather every living thing both controls and is controlled.

Thus, every animal or human holon has a control component, i.e., a leader, manager, leadership team, or management team (Law B02). If the control component comprises more than one individual, then it too has a control component. By recursion, this continues until a single individual is reached.

The control component co-ordinates the activities of other members of the holon. For a holon to be formed, it is not necessary that every pair of components cooperate horizontally with one another. However, they must cooperate vertically with the control component whether this be voluntary or coerced. (Law B03)

Human holons form a nested hierarchy (Law B04) and this creates a leadership or management hierarchy of individuals (Law B05). The objectives and personality traits of those individuals have a significant impact on the culture and purpose of the holon. It is natural to select leaders using a bottom-up process, i.e., followers choosing a leader thought to be best qualified to co-ordinate their activities. However, managers are frequently chosen by a top-down process whereby senior managers select junior ones thought to be best suited to what the former perceive to be the role. Again, the objectives and personality traits of the senior manager have a significant impact on the type of junior manager chosen. Both processes allow leaders to be changed according to circumstances, but again, these changes are either bottom-up or top-down.

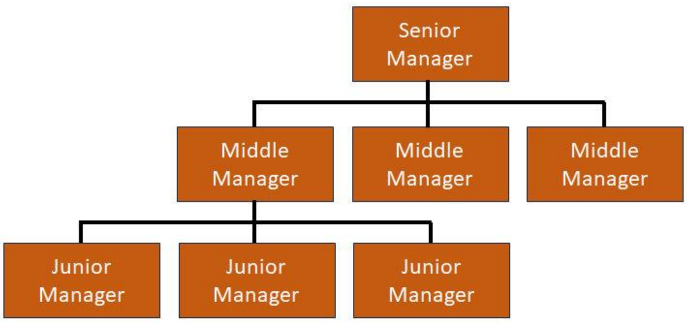


Figure 2 *- The classical management hierarchy.*

5. Principle 4: Needs

Human needs are internal physiological or psychological states which can be satisfied by interaction with our environment. They form the basis of our behaviour. For example, if we are hungry, then we seek food. In his 1943 paper, "A Theory of Human Motivation", the humanist psychologist, Abraham H. Maslow was the first to formally identify our needs. His suggestions are listed below. (Maslow, 1943).

Physiological needs. These are health and physical wellbeing and are satisfied by air, food, water, shelter, clothing, sleep, sex, etc.

Safety and security. Feelings of safety and security, including freedom from fear, which can be satisfied by employment, social support networks, insurance, property ownership, financial security, family, social stability, etc.

Love and belonging. A sense of connection with others which can be satisfied by being accepted as a group or family member, friendship, intimacy, etc.

Self-esteem. Possession of a sense of personal value, confidence, self-regard, mastery, and the feeling of being unique. It can be satisfied by achievement, recognition by others, and the respect of others.

Self-actualisation. This means being fully oneself and possessing morality, creativity, spontaneity, acceptance, experience, purpose, meaning, and inner potential. Self-actualisers can appear in any field, for example Einstein in the field of science, Roger Federer in sport, Michelangelo in art and, if the myths are true, the Buddha in spirituality.

Maslow explained that human behaviour is motivated by a requirement to satisfy these needs (Law C05). Without them behaviour would not exist, and we would be unable to function.

According to Maslow, needs form a hierarchy with physiological needs at the bottom and self-actualisation at the top. People must satisfy needs lower in the hierarchy and ensure that this satisfaction is sustained before effort is expended on higher needs. He does, however, qualify this by referring to degrees of relative satisfaction. It is not the case, he argues, that a need only emerges when those lower in the hierarchy have all been fully satisfied. Rather people are usually in a state where all their needs are, to a greater or lesser degree, only partially satisfied. Furthermore, the level of satisfaction of their needs tends to decrease as we ascend the hierarchy. A higher need may not be apparent at all if lower needs are not adequately satisfied. However, it will emerge by degrees as their level of satisfaction increases. Once a need is satisfied, however, we do not ignore it but continually return to it to ensure that it remains so.

Maslow's paper was instrumental in changing the focus of psychologists from abnormal to normal behaviour. Unfortunately, it was also largely speculative and based on personal observation. Furthermore, subsequent research does not support the position of each need in a hierarchy. Not all psychologists agree with his theory, therefore. It is probably too detailed and fails to recognise inherited differences, learned differences, and those arising from culture.

Several alternative models to Maslow's hierarchy of needs have been suggested, for example, the ERG or existence, relatedness, and growth model proposed by Clayton Alderfer. (Alderfer, 1972). Alderfer's existence needs correspond to Maslow's physiological and safety needs, his relatedness needs to social belonging and self-esteem, and his growth needs to self-actualisation. Alderfer proposed that individuals can be motivated by several levels of need at any one time, but that their relative priority can change according to circumstances and the individual's way of thinking.

However, a modified version of the ERG model may reflect reality more accurately. This model refers to behavioural predispositions. These are states of mind which do not necessarily lead to immediate action, but which prepare us to act when the opportunity to satisfy a need arises. They are like bowstrings drawn by a need and released by an opportunity. However, if a need is sufficiently pressing, we will attempt to create those opportunities.

The model also refers to the multi-level selection theory of evolution. There has been much academic debate between evolutionary biologists, such as John Maynard Smith, W. D. Hamilton, George C. Williams, and Richard Dawkins, who advocate individual level natural selection plus rare cases of kin level natural selection, and others, such as David Sloan Wilson, Elliott Sober and E.O. Wilson, who advocate multi-level natural selection. However, a consensus is beginning to emerge that a process of natural selection occurs at each biological level, i.e.: the genome, cell, organism, family, group, species, and ecosystem. Due to emergent properties, i.e., properties held by systems which are not held by their component parts, the process of natural selection at each level can differ. However, the process at each level tends to be undermined by stronger selection processes at lower levels.

Multi-level selection theory can be described using the analogy of Russian dolls. The various biological levels can be likened to nested containers for competing genes. To varying degrees, the genes rely on each container for their survival and propagation. Thus, higher level selection can be a significant factor in some species and has probably played a part in human evolution.

The model proposed for the purposes of social systems theory is, therefore, as follows.

Existence and procreation needs. Unsatisfied physiological and safety needs, provide the strongest behavioural predispositions. All living things, since they first appeared, have physiological needs. These needs have the longest history, the most firmly established presence in living organisms, and are responsible for our strongest behavioural predispositions. This means that there is a hierarchical relationship between existence needs and all other needs and that they must be adequately satisfied before we attend to others.

Kin relatedness needs, if unsatisfied, provide the second strongest predispositions. Kin level selection is shared only by organisms with the cognitive ability to recognise their kin. It applies to the family part of our relatedness needs. These needs emerged more recently in evolutionary history, and the predispositions they endow are, therefore, somewhat weaker than those for individual level selection. Family members capable of procreation, i.e., the younger members, tend to be favoured, but elders are also valued for the support they give. The predispositions provided by relatedness needs vary in strength among humans. In extreme cases, individuals, such as those with anti-social personality disorder (ASPD), may have no predisposition to family relationships at all.

Non-kin relatedness needs, if unsatisfied, provide the third strongest predispositions. Group level selection is limited to just a few eusocial species that live in cooperative groups, including humans, and, in mammals at least, is very recent in evolutionary terms. The predispositions arising from group relatedness needs are, therefore, weaker than those for kin relatedness and existence needs. Again, their strength varies from individual to individual.

Growth needs, or self-actualisation needs, if unsatisfied, provide behavioural predispositions of different strengths. The evolution of our large brains in parallel with our emerging eusociality has given us cognitive and physical skills together with the need to employ them. In satisfying our relatedness and growth needs, we face the dilemma of whether our chances of survival and procreation and those of our kin are best served by attending to growth needs or relatedness needs. Our choice does, of course, depend on our circumstances and way of thinking. Depending on these, the priority given to growth needs can, therefore, be greater than or less than those of kin or non-kin relatedness.

These priorities are supported by evidence from four decades of extensive international research carried out by the World Values Survey. A summary is given in Ronald Inglehart's book "Cultural Evolution" (Inglehart, 2018). When people are unable to take basic survival needs for granted, the focus is on those needs plus social connections. That is, we focus on our existence, procreation, and relatedness needs. However, when people do take basic survival needs for granted, as is the case for most of us in the West, the focus moves on to social connections and self-expression. In other words, we focus on our relatedness and growth needs.

In summary, therefore, the pyramid traditionally used to describe the hierarchy of needs is probably better represented as follows.

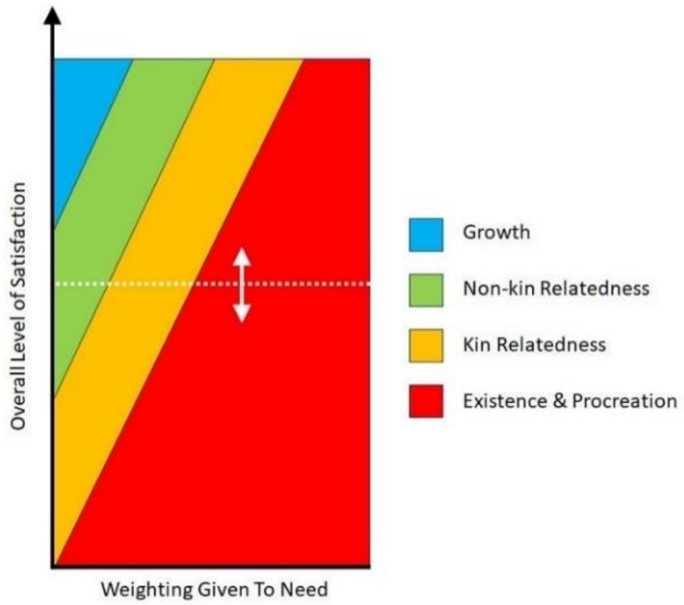


Figure 3 *– The possible weight that we give to our needs compared with our overall level of satisfaction.*

All human holons comprise components that cooperate vertically with a control component and have needs similar to those of individuals. The explanation for this is as follows. Cognitive physicalist philosophy holds that even abstract things such as relationships and characteristics are physical in nature. Thus, a relationship between two people is those two people. If the two people have similar needs and work together to satisfy them, then the resulting holon will reflect those needs.

We recognise such groups because they occur frequently in society. Each is a human holon that comprises several smaller ones. These smaller ones are the individuals or groups that are constituted in the same way, plus any other living things, such as horses, and any artifacts, such as computers, necessary for the smaller groups to work together. Even individual people rely on other living things and artifacts. Examples include guide dogs for the blind and heart pacemakers. So, the needs of these things must be included with those of the individual. In the case of a human holon, its needs comprise an aggregate of the common needs of the individuals concerned, and those of any other living things or artifacts necessary for its components to work together.

The needs of human holons are prioritised using the same categories as those identified for individuals by Abraham Maslow and Clayton Alderfer, i.e., existence, followed by relatedness, in particular family relatedness, followed by growth.

Weighting the needs of oneself and others.

Individual people give a relative priority or weight, to their own needs and those of other living holons. This weight depends on the distance of the holon from the individual and the latter's personality traits. Normally, we give greatest weight to ourselves, followed by close family, followed by more distant relatives, followed by those unrelated to us. The rate at which this weight tapers off with distance depends on factors such as empathy and whether we have dark personality traits.

The same is true of larger human holons such as nations and organisations. The familial relationships between them affect the weights given to their needs in the same way as the familial relationships between individuals. The culture of a human holon also plays a part in the rate at which this weight tapers off with distance. For example, a business with a "bottom line" culture gives a very high weight to its own needs and a very low one to those of others.

This is consistent with the multilevel selection theory of evolution. This theory holds that individual people place greatest weight on personal survival and reproduction, followed by that of family members, followed by the community upon which they depend, and finally, by those more remote. By inference, the same must be true of human holons comprising more than one individual.

6. Principle 5: The nature of interactions

A. Satisfiers and contra-satisfiers

In the 1990's, to address some of the limitations of Maslow's theory, the Chilean economist Manfred Max-Neef and his colleagues developed an alternative way of categorising human needs. Details can be found in their 1989 book "Human Scale Development". (Max-Neef, 1989)

Max-Neef's principal contribution, however, was the identification of "satisfiers". These are external things which assuage our needs. Examples include physical things, such as rice and houses, or actions by others, such as medical treatment. Max-Neef explained that external things, such as food and shelter, should not be seen as needs, but rather as external satisfiers of an internal need for subsistence. On the micro-scale, satisfiers can be the goods and services that form the basis of economics. On the macro-scale, they can be the institutions that form the basis of politics. Satisfiers can, therefore, also be provided by organisations, by the way in which society is organised, or by its culture. For example, education is a satisfier of the need for understanding, and healthcare a satisfier of the need for protection.

As an economist, Max-Neef's focus was mainly on physical and cultural satisfiers. However, there are also psychological satisfiers, such as the various belief systems on offer.

Max-Neef held that fundamental human needs are a constant, but that societies alter the satisfiers of those needs. Thus, satisfiers may differ from nation to nation, culture to culture, and time to time. He also held that there is not necessarily a single satisfier for any one need. Rather, several different things may satisfy it. Nor is a satisfier necessarily associated with a single need. Rather, it may assuage several. He cited the example of a mother breastfeeding her baby and argued that this can satisfy the baby's need for subsistence, protection, affection, and identity all at the same time.

Although anything can be a satisfier, not everything is a satisfier. Max-Neef used the following classification:

“Synergic satisfiers” [1] satisfy a given need, whilst simultaneously contributing to the satisfaction of others. They are generally those chosen by the individuals concerned as best satisfying their complex of needs, rather than those chosen by any external agency, particularly an authoritarian one, whose motives often differ.

Singular satisfiers satisfy only one need and are neutral in respect of others. They are often a consequence of well-meaning, but remotely planned interventions by voluntary, private sector, or government organisations. Examples include food and housing programmes.

Inhibiting satisfiers over-satisfy a particular need. They can become addictive, and so, prevent a person from satisfying other, higher needs. Max-Neef and his colleagues believe that inhibiting satisfiers originate in deep rooted customs, habits, and rituals. An example is the addictive pursuit of wealth among those who already have sufficient to meet their needs. This can lead to a failure to move on to other needs such as raising a family. Another example is drug addiction which becomes an artificial existence need and prevents an individual from adequately addressing higher needs.

Pseudo satisfiers claim to be satisfying a need, but really provide little or no satisfaction. They are often associated with advertising. Products may, for example, be marketed as glamour or lifestyle accessories, with the implication that they will improve the purchaser’s self-esteem.

Violators. These are things which, although they are claimed to satisfy a need, actually make it more difficult to do so. Max-Neef used the example of a drink advertised as being thirst quenching but which, due to its ingredients, causes dehydration. By their nature, violators are also often associated with the consumer economy and marketing.

Contra-satisfiers were not identified by Max-Neef but are those things which reduce the level of satisfaction of our needs. For example, crime and war can lead to insecurity, injury, and death. What acts as a satisfier to one party can of course act as a contra-satisfier to another.

Satisfiers and contra-satisfiers form the basis of interactions between human holons. An interaction involves the provision of a satisfier or contra-satisfier to one party, the recipient, by another, the supplier. Such interactions are frequently reciprocal, but not necessarily so. Satisfiers and contra-satisfiers can be space, matter, energy, or information. For example, the space provided by a factory can be a satisfier of a business’s need for production; sunlight is energy that satisfies the needs of plants; those plants in turn can be food that satisfies the needs of animals; material resources satisfy the needs of a manufacturing business; and information, whether true or false, can satisfy our need for growth.

B. Sources of satisfiers

The more similar the needs of two living holons the more similar the satisfiers and contra-satisfiers of those needs. Thus, for example, individual organisms within the same species seek to acquire the same existential satisfiers and avoid the same existential contra-satisfiers (Law F03).

There are many satisfiers, and their nature determines the function of their source. The more specialised this function, the fewer the sources, and the more likely it is that two human holons with a common need will share the source of a satisfier (Law F04) & (Law F05). The source of a satisfier also depends on the geographical location and culture of the holon. Sources closer to and with a similar culture to the holon tend to be used first. Thus, the closer two holons are geographically and culturally, the more likely they are to share the source of a satisfier (Law F06) & (Law F07). The more likely it is that two living holons share the same source of a satisfier the less likely it is that the satisfier will be sufficient for both (Law F08).

C. Perceptions of satisfiers and contra-satisfiers or of benefits and threats

It is the perception of a potential satisfier or contra-satisfier that determines the behaviour of a living holon, and not necessarily its actuality (Law C10). This perception exists on at least three levels, each building on the information in the one below:

Level 1. Whether or not a satisfier or contra-satisfier can be physically observed. This information is normally true, although it is possible to misinterpret observed events.

Level 2. Beliefs about the existence or otherwise of a Level 1 satisfier or contra-satisfier, as passed from one holon to another. This perception can be influenced by the social transmission of information and the reinforcement of beliefs by socialisation, i.e., reward for compliance and censure for non-compliance. This information can be true or false. It is not uncommon for people to propagate false information in their self-interest. It is also not uncommon for ideologies to be based on it. (Law A03)

Level 3. Beliefs about Level 2 beliefs and their effect on a culture. For example, concerns about false beliefs propagated by an ideology.

D. Power, property & money

Power can be defined as the control of satisfiers and contra-satisfiers for oneself and others. If we control a source of satisfiers or contra-satisfiers, then that source is regarded as property. Money is information and property that acts as a satisfier for the recipient and a contra-satisfier for the giver.

In early human society we relied on geographical territory to satisfy our needs. It provided, for example: drinking water; plants and animals for food; space and materials for shelter; and so on. Territory was, therefore, a major satisfier. It came to be regarded as property and was vigorously defended. This trait is not unique to human beings, of course. It also appears in many animals. However, human beings differ from the latter in an important way. Both have concepts of “what is me” and “what is mine”. But human beings also have concepts of “what is you”, “what is yours”, “what is us”, “what is ours”, “what is them”, and “what is theirs”. These ideas lead to the concepts of property and property rights. As human society became more complex, as people specialised and traded, and as populations grew, ever fewer of us had access to geographical territory. In modern Western society today hardly any of us satisfy our needs in this way. However, money has come to replace geographical territory as a source of satisfiers by virtue of its use in trade. The “what is…” concepts now apply to it as much as to any other property.

Many human interactions involve a flow in one direction of real satisfiers or contra-satisfiers, i.e., space, materials, energy, or information, and the flow of money in the other. Money is not in itself power, but rather something that can be traded for more tangible satisfiers and contra-satisfiers. It can, therefore, be regarded as information and property that acts as a satisfier to the recipient and as a contra-satisfier to the giver. However, not all transactions involve the trade of real satisfiers or contra-satisfiers for money. The direct barter of real satisfiers for real satisfiers still exists, particularly at the level of interaction between individuals, and particularly when information is the satisfier. The control of money, although it is equivalent to the control of satisfiers, is therefore just one component of power.

The amount of power that we have lies on a scale from total powerlessness to absolute power. There is a point at which our power is just sufficient for the satisfaction of our own needs and those of our dependents. Power below this point is referred to as Type A and above it as Type B. We do not normally refer to Type A as power, however. In its absence, we are in a state of powerlessness and, in its presence, a state of freedom or independence. Type B is excess power and comprises the control of satisfiers and contra-satisfiers for others, and so, it can be used to control them. This control of others can become a need, whose satisfier is Type B power.

Type B power can be traded with others to yield a net benefit. That is, some can be delegated to others in return for support that brings with it greater power. To persuade others to trade in this way, it is necessary to demonstrate one's power by overtly displaying wealth and control. In this way, a hierarchy forms that is based on type B power and the control of others (Law E03).

The control of others is an unsatisfiable need, because, in practice there are always others with greater power. If an individual or larger human holon prioritises its need to control others and pursues it without restraint, then this will consume endless resources. However, the resources that any holon can generate are finite. So, if vertical cooperation is attempted with such holons, then ultimately, some of the junior partners must face a situation in which the disbenefits outweigh the benefits. Their share of the satisfiers will fall below the threshold necessary to satisfy their needs and those of their dependents. No living holon will voluntarily interact with another unless there is believed to be a net benefit in doing so (Law D03). So, any voluntary vertical cooperation will fail (Law J03).

An unsatisfiable need for the control of others must, therefore, ultimately lead to attempts acquire their involuntary vertical cooperation or to coerce (Law N01). Without resistance, involuntary vertical cooperation or coercion becomes the accepted norm (Law N03). However, with resistance, attempts at coercion can fail, and the relationship remains one of voluntary vertical cooperation. Alternatively, however, conflict can result (Law O01).

Once a holon forces involuntary vertical cooperation or engages in coercion it cannot give up its power without facing retribution (Law N04). Thus, for example, autocrats will cling to power.

7. A simplified model of the human holon

A simpler model of a human holon than that provided by Stafford Beer is given below. Human behaviour, whether that of an individual or that of a larger human holon, is the consequence of a decision-making process. The causes of that behaviour, the decision making process, and the behaviour itself regarded as a system with inputs processes and outputs. The diagram below describes this system.

The human holon is part of a nested hierarchy comprising other systems. They are arranged as follows. The control component, in the case of an individual, is his mind, and in the case of a larger holon, its leader. Together, the mental and physical resources that they directly control, i.e., the body of an individual or the people in a larger holon, comprise the operational system. The operational system, together with the resources that it owns, comprise the resource system. Finally, the behaviour system comprises the resource system plus actual behaviour.

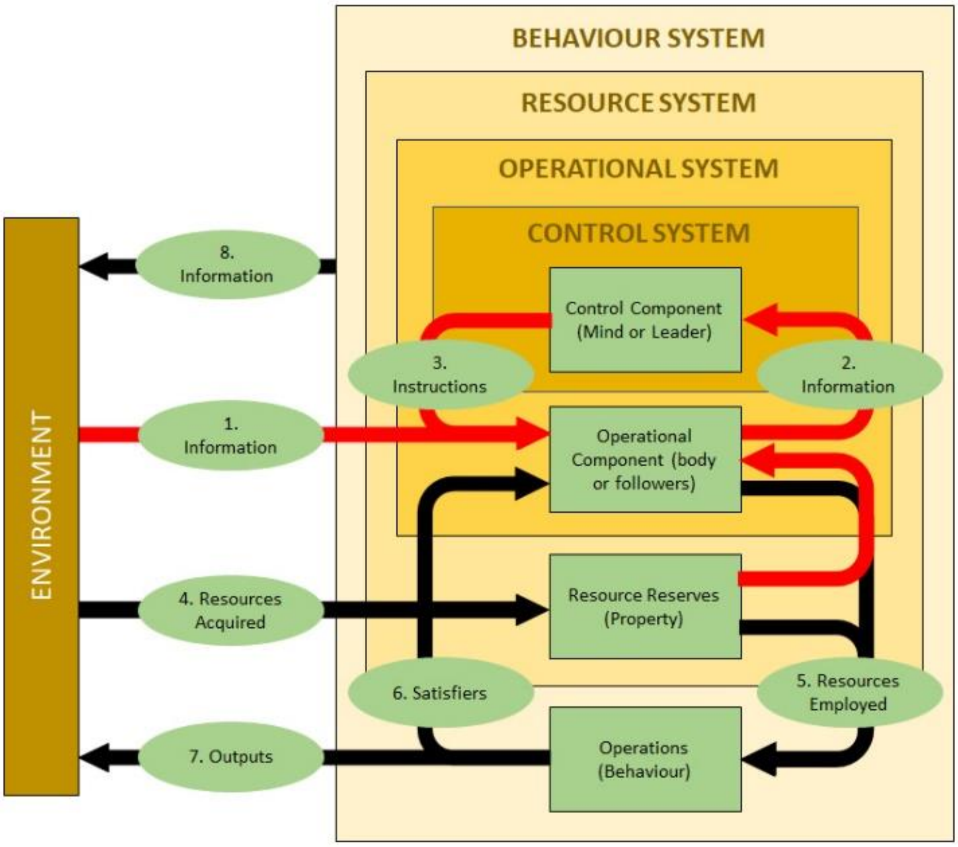


Figure 4 *- A Simplified Model of a Human Holon*

These systems operate in the following way. Paragraph numbers refer to those in the diagram.

1. The environment comprises everything that is not a part of the system. It includes both the natural and the social environments. Inputs from the environment enter via the operational component. These inputs include satisfiers, contra-satisfiers, risks, and opportunities. The relevant parts of the operational component are, in the case of an individual person, the physical senses, or, in the case of a larger holon, specific people. For example, an individual person may perceive a wasp as a threat of injury, or a government may see another nation as an opportunity for trade.
2. Information from the environment is passed from the operational component to the control component, i.e., the mind or leader, where decisions are made. The operational component also monitors the state of resources and satisfiers, i.e., those things that satisfy the individual or larger holon's needs. For example, an individual may recognise that food in the refrigerator is running low, or a business that its stock of spare parts is too high. It also passes this information to the control component.
3. In return for this information, the control component makes decisions, and then, passes instructions to the operational component. These instructions are based on a risk, benefit, cost analysis using the status of satisfiers, the resources required to create them, the status of contra-satisfiers, and the resources required to avoid them. The value allocated to a satisfier or contra-satisfier depends on the interaction style of the control component, i.e., whether it is co-operative, positively competitive, or negatively competitive. A negatively competitive individual may conclude that shoplifting is the way to fill their refrigerator. A government with a co-operative style may see a trading alliance as the way to improve their economy.

4. Resources are acquired from the environment and become part of the resource reserves of the system, i.e., its property. They can be space, matter, energy, or money. Resources can be acquired directly from the natural environment, or through trade with other individuals or larger holons. For example, early humans were hunter-gatherers and acquired their food directly from nature. Today, however, many of us buy our bread from a baker or supermarket.
5. The activities of the operational component, together with resources taken from reserves, act as inputs to the operations process. These inputs are satisfiers for the process. The operations process converts these resources into outputs. So, for example, an individual may cook the food in their refrigerator to create a meal. A business may assemble parts, or mix constituents, to create a saleable product.
6. Some of these outputs are satisfiers for the operational component. We may, for example, eat part of the meal we have prepared to satisfy our personal need for sustenance. Similarly, governments and businesses pay the people who carry out their function.
7. Other outputs can be satisfiers or contra-satisfiers that are used to trade for resources from other individuals or larger holons. So, we may trade our labour for pay or provide a meal to friends in return for their friendship. Businesses do, of course, provide goods and services in return for payment. Alternatively, outputs can be operations on the natural environment to acquire resources, e.g., mining, hunting, or gathering. All behavioural outputs are constrained by the physical resources available, for example, an individual's physical abilities. They are also constrained by the operational resources owned, for example, the financial capital of a business.
8. Finally, behaviour can be observed, and so, the system of which it is a part outputs information to the environment. We can, for example, watch a football match or observe government activities, and thus, criticise them.

Human holons are recursive. Every holon comprises several lesser ones. Every human holon, together with others, is also part of a larger one. This recursion continues downwards to individuals and upwards to all of humanity. This model describes the behaviour of every individual or larger holon in that structure.

8. Principle 6: The range of interaction types

Human holons form a nested hierarchy with many levels, e.g., individuals, organisations, sectors, nations, and humanity. Horizontal interactions take place between holons at the same level and vertical interactions between holons at different levels. Those interactions can be classified, for example, as cooperative, competitive, coercive, and so on. The actual range of interactions is determined by Principle 8 and will be discussed in that section. Although there are differences in the relative likelihood and frequency of each type of interaction, the same range of interaction types applies to both horizontal and vertical interactions (Law C01).

9. Principle 7: Choosing whether and how to interact

A. Introduction

All human holons constantly act and all acts, no matter how minor, are a result of decisions. When deciding whether to interact, both individuals and larger human holons carry out a form of risk, benefit, cost analysis. The decisions of individuals are normally based on the impact of the relevant satisfiers and contra-satisfiers on their needs, and hence, on their emotional state. Larger human holons can, of course, carry out more formal assessments using, for example, mathematical techniques. However, because these larger holons are led by individuals, their decisions can also have an emotional basis.

B. Conscious Rational Decisions

To give the reader an idea of how difficult it can be to make conscious rational decisions, the variables involved are shown in the following equation. The net benefit or disbenefit to the decision-maker $\mathbf{b_1}$ is given by the recursive equation:

$\mathbf{b_x = \Sigma_s\Sigma_h pdb_{x+1}\Sigma_n fnc}$ whose variables are as follows.

c is the change in level of satisfaction of a holon's need. This is positive for an increase and negative for a decrease.

n is the weight of the holon's need according to its position in the hierarchy of needs. This is 1 for an existence need and decreases as the hierarchy is ascended. However, the weights will differ depending on the holon and its circumstances.

f is a discount factor that brings all future changes in the level of satisfaction of a need to an equivalent present-day value.

Σ_n is the sum of these weighted and discounted changes in the holon's needs.

$\mathbf{b_{x+1}}$ is the benefit or disbenefit that the holon currently brings to itself and others. This is calculated using the same equation but $\mathbf{b_x}$ becomes $\mathbf{b_{x+1}}$ and $\mathbf{b_{x+1}}$ becomes $\mathbf{b_{x+2}}$.

d is the weight given to the holon according to its familial relationship to $\mathbf{b_1}$. If $\mathbf{b_1}$ is the holon, then this is 1, and the weight decreases to 0 with distance. However, the rate at which it decreases can differ for each holon, depending on its level of empathy and whether it has dark traits.

p is the probability that the holon is affected by a satisfier or contra-satisfier that $\mathbf{b_x}$ provides. This is 0 for impossible, and increases to 1 for certain.

Σ_h is the sum for all holons affected by a satisfier or contra-satisfier that $\mathbf{b_x}$ provides.

Σ_s is the sum for all satisfiers and contra-satisfiers that $\mathbf{b_x}$ provides. In the case of $\mathbf{b_1}$ this is the satisfiers and contra-satisfiers that $\mathbf{b_1}$'s decision provides.

This equation is recursive. It considers the holons directly affected by the act and also those indirectly affected. Clearly, this feature and the number of variables involved make it impossible to carry out such an analysis, even if we had the time. Furthermore, the use of mathematics is very recent and is not something that we do instinctively. Instead, we use emotion as follows.

C. Emotion-based decisions

The process involved in emotion-based decision-making is biological in nature and has almost certainly evolved in animals over time. Simpler versions of the process are likely to exist in non-human animals and are also likely to have existed in our ancestor species. The various emotional associations, weights, and thresholds are established by a combination of genetics, socialisation, and experience. The process is like that of an analogue computer. It uses continuous variation of the factors involved in making a decision to increase or decrease our negative emotional state. The process can be carried out relatively quickly and unconsciously. For example, it takes relatively little time to know whether we are happy or unhappy with a proposed course of action.

The process is as follows.

1. **Positive and negative emotions attach to needs.** Typical positive emotions are happiness, joy, and exhilaration. Typical negative ones are fear, disgust, and anxiety. If our needs are fully satisfied, then our emotions are neutral. However, the less satisfied our needs, the needs of those close to us, and the less secure that satisfaction, the more negative our emotional state.

2. **A satisfier increases the level of satisfaction of a need.** A satisfier can increase the level of satisfaction of several needs. For each, the greater the increase, the greater the reduction in negative emotion. For a short time, we may also experience a positive emotion. Positive emotions are, however, transient. This is because we must continually act to survive, and positive emotions reduce our motivation to do so. So, they merely act as a short-term reward for successful acts.
3. **A contra-satisfier reduces the level of satisfaction of a need.** A contra-satisfier can decrease the level of satisfaction of several needs. For each, the greater the change in the level of satisfaction, the greater the increase in our negative emotional state.
4. **The emotional change associated with a need depends on its position in the hierarchy of needs.** The lower a need in this hierarchy the greater the emotional change. Greatest change is normally associated with existence needs. For example, if we are hungry and wish to socialise, then sustenance will have a higher emotional impact than a visit to friends.
5. **The emotional change associated with a need depends on its existing level of satisfaction.** The less satisfied a need, the greater the emotional impact of the same increase or decrease in level of satisfaction. If our level of satisfaction is low, then we will welcome an increase or regret a decrease more than if it were high.
6. **The emotional change associated with a need depends on our relationship to the beneficiary or victim.** The further the beneficiary of a satisfier or the victim of a contra-satisfier is from us, the less the change in our emotional state. This distance is based on familial relationships. The British evolutionary biologist W.D. Hamilton proposed that individuals weight the needs of others according to the percentage of the variable human genome we believe them to share with us (Hamilton, 1964). So, in general, the weight that individuals give to the needs of others decreases in the following order: ourselves, a member of our nuclear family, a member of our extended family, a member of our society, a more distant person, and finally an animal. The rate at which the change in our emotional state tapers off with distance can, however, vary from individual to individual. It depends on our level of empathy, and the extent to which we have dark psychological traits. Empaths will give a higher weight than average to the effect of satisfiers and contra-satisfiers on others; psychopaths will give the same effects a lower weight than average. Greater support is also given to those with a shared culture. The same is true of human holons comprising more than one individual. The weight they give is based on the distance of the familial relationship, the traits of the leader, and the culture of the holon.
7. **The more distant in the future the change in the level of satisfaction of a need, the less the change in our emotional state.**
8. **Each satisfier or contra-satisfier is given an emotional value.** The emotional value of a satisfier or contra-satisfier is the sum of the emotional changes associated with the needs that it affects. We then remember these emotional values for use as future shortcuts to decision-making. Thus, for example, there are things that we love and things that we hate.
9. **The emotional value of a satisfier or contra-satisfier is affected by its status.** Acts can deliver satisfiers or contra-satisfiers of different status. Statuscan vary from absent, through latent and precarious to entrenched. For example, a promise is a latent satisfier and a threat a latent contra-satisfier. The diagram below shows the effect of status on emotional value.

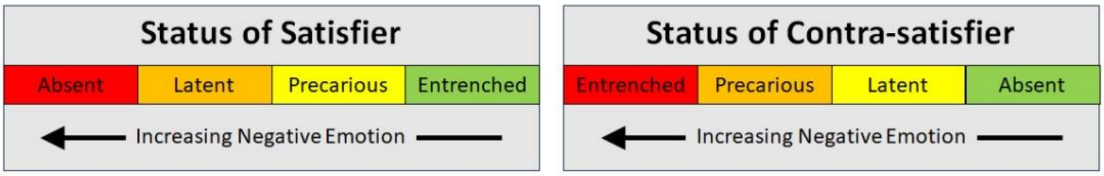


***Figure 5** – The effect of status on the emotional value of a satisfier or contra-satisfier.*

10. **The emotional value of a satisfier or contra-satisfier is affected by its likelihood.** Satisfiers or contra-satisfiers are not necessarily guaranteed to be delivered by an act. There may only be a probability of them resulting. The lower this probability, the lower the emotional value of the satisfier or contra-satisfier.
11. **The emotional value of a satisfier or contra-satisfier is affected by beliefs.** There are many ways in which we come to hold beliefs about the way that a satisfier or contra-satisfier will affect our needs. Examples include experience, learning from parents and other members of our community, observation of role models, advertising, and so on. These beliefs may be correct, or they may not. Nevertheless, they are what influences our decision making.
    - Socialisation affects the emotional value that we attach to satisfiers and contra-satisfiers. For example, continued exposure to advertising can create a belief that products and services will reduce negative emotions, and thus, lead us to indulge in "retail therapy". Socialisation can also affect how we vote in elections.
    - Cultural values and norms, i.e., our understanding of acceptable social behaviour, also affects the value that we attach to satisfiers and contra-satisfiers. They will, for example, determine whether we will receive positive or negative regard from others. Regard is, of course, a satisfier of our relatedness needs. Again however, there is considerable variation between individuals. For example, narcissists will give a higher weight than average to the need for positive regard. Cultural values and norms also create what we refer to as conscience. Acting contrary to conscience generates the negative emotion of guilt.
12. **Enhancement of satisfiers and mitigation of contra-satisfiers.** All acts result not only in benefits, i.e., satisfiers, but also disbenefits, i.e., contra-satisfiers (Law D01). So, ways of enhancing the former or mitigating the latter are identified and the proposed act altered to suit.
13. **Resources used in an act are a contra-satisfier.** Whenever we act, we use resources. These can be material, or they can be personal time or effort. This use of resources is a contra-satisfier whose emotional value can be assessed in the same way as any other.
14. **The net emotional value of an act.** The decisions that we make are normally intended to reduce our negative emotional state and to produce a short-term reward in the form of positive emotion. It is the aggregate change in emotional state that motivates our behaviour. So, we then total the adjusted emotional values attached to all satisfiers and contra-satisfiers to assess the overall change in our emotional state. If the result is an overall reduction in negative emotions, then we are predisposed to act. If it is an increase, then we are not.
15. **Predisposition to act.** The result can be a predisposition to act. If the needs are pressing then we will actively create opportunities to acquire satisfiers or avoid contra-satisfiers. Otherwise we may wait for suitable opportunities to arise.
16. **Biochemical reactions.** However, if events cause an overall change in our emotional state that is greater than a certain threshold, then this can trigger a biochemical reaction, such as the fight or flight syndrome.

D. Emotion-based decision-making in practice

In the 19th Century, the German physicist, Hermann Helmholtz, identified three stages in the creative process, including decision-making. They are saturation, incubation, and illumination. The French mathematician Henri Poincarre later added a fourth stage: verification. (Sadler-Smith, E., 2015)

Saturation means consciously researching and learning as much as we can about the issue under consideration. Consciousness allows us to rehearse the skills and knowledge gained, thereby storing it in long term memory and reinforcing it.

Incubation means allowing the mind to process that information with a view to seeking some output. If the output is a decision, because the unconscious mind was first to evolve, the process is carried out unconsciously. This process is opaque to the conscious mind. We can only deduce what it may have been, and so, must often rationalise. However, the process is biological in nature involving the creation of new neurones and the trimming of old ones and is particularly active when we sleep. Both our conscious and unconscious mind employ the same resources, knowledge, skills, and memories. However, the conscious mind takes charge of these shared resources and focuses them on the topic in hand. Relaxing the conscious mind allows the unconscious to roam more freely over these resources, compare it for similarities, and make associations more readily. Thus, it is necessary for us to reduce our levels of consciousness to allow the unconscious mind to function effectively.

Illumination occurs when the unconscious mind delivers the result of its deliberations to the conscious one. This often occurs in the form of an inspiration, e.g., a potential solution to a problem, and can be accompanied by a surge of positive emotion. These inspirations can be original because of the quantity of information that they draw on. However, inspirations can be unreliable for several reasons. For example, we may simply have the facts wrong; there may be mistakes or cognitive biases in the unconscious process; or there may be unconscious beliefs and attitudes that we have picked up from advertising, our peers, etc.

Verification, therefore, is the final stage in which we consciously check that the inspiration is valid and ethically acceptable. This is done by awakening consciousness and using logic, reason, the known facts, and our ethical schema. If the conscious mind finds the inspiration to be unsatisfactory, it can "train" the unconscious mind by vetoing its decision and asking it to think again. It can also engage in further saturation. So, decision-making can be an iterative process. Once the conscious mind finds a decision to be satisfactory, then it does of course approve it for action. (Challoner, 2021)

There are, however, three circumstances in which we do not carry out verification.

1. We have no time and the unconscious decision has to be trusted before events make the decision for us (Kahneman D., 2011).
2. Circumstances defy rational analysis, and we must accept our "gut feeling".
3. The unconscious mind has been adequately trained, its decisions can be trusted, and we can act on "autopilot".

Unfortunately, we suffer unconscious cognitive biases. These are shortcuts to decision making carried out under the pressure of circumstances. They are often not entirely logical and are certainly not consciously considered, but they do have the advantage of being correct much of the time. We use them when there is no time to consciously review our decisions before events decide the outcome for us. It is more beneficial to take an action quickly and unconsciously, even if there is only a limited likelihood of success, than to engage in conscious reasoning and, during that process, experience failure.

Decisions made by holons comprising more than one person can differ in several respects. A decision is more likely to be based on research and consciously reasoned argument. There may be formal established processes. Debate and consultation may be involved, bringing with them the perspectives and interaction styles of several individuals. Nevertheless, every holon is ultimately led by an individual person, and they are subject to the emotional processes described above. As a minimum, this can influence the decision. A recent example is the disastrous economic decisions made in 2022, against all advice, by the UK's 50-day Prime Minister.

10. Principle 8: The social/ecological isomorphism

A. Introduction

This principle states that the types of interaction between holons in human society are the same as those encountered in ecology (Law C02). For example, competition, co-operation, and coercion can be found in both human society and in natural ecosystems.

Historically, much emphasis has been placed on competition in the natural world, and to some extent, this persists in the literature today. However, the term "the fittest" in the phrase "survival of the fittest" means the most suited to survival and procreation within its environment. It does not mean the most successful competitively. David Graeber and Andrej Grubačić argue that the focus on competition in evolution was "an attempt to catapult the view of the commercial classes into universality." (Graeber & Grubačić, 2021). This was not Darwin's interpretation, but rather that of the commercial classes and politicians to justify laissez-faire economic policies, liberalism, imperialism, and eugenics. In practice, although "the fittest" does mean the most successful, this success is often based on cooperation.

This section examines the different forms of interaction found in nature and compares them with those in human society. The names used for these interactions differ in the two contexts. Furthermore, they are given different meanings by different authors. So, it has been necessary to define them more precisely. To do so, a symbolic representation has been developed.

Interactions between species are referred to as interspecific, and those within species as intraspecific. Humanity is, of course, a single species, and so, all human interactions are intraspecific. Thus, a comparison can be made between human and non-human intraspecific interactions.

However, a comparison can also be made between interactions between species in the natural world and interactions between holons in human society. This is because human society comprises different cultures, and different cultures are held in the minds of different individuals. If geographical or social separation were to persist, these different cultures would ultimately result in the evolution of different species.

B. Terms used in ecology

The terms used in ecology to describe a relationship between two organisms, groups of organisms, or species, i.e. living holons, are used differently by different authors. The definitions used here are as follows:

- Symbiosis means that the two parties benefit from the relationship.
- The opposite of symbiosis is antibiosis in which at least one party is harmed.
- Commensalism means that one party benefits, whilst the benefits or harms to the other are negligible.
- The opposite of commensalism is amensalism in which one party is harmed, whilst the benefits or harms to the other are negligible.

- Neutralism means that neither party benefits and neither is harmed.

This is summarized in Table 1 below. The letters x and y are the parties to the interaction, “+” indicates that the party benefits, “-” that it is harmed, and “o” that it neither benefits nor is harmed. Terms that are opposites of one another are shown in bold text or italics.

		y		
		+	o	-
x	+	*Symbiosis*	**Commensalism**	*Antibiosis*
	o	**Commensalism**	Neutralism	*Antibiosis* or **Amensalism**
	-	*Antibiosis*	*Antibiosis* or **Amensalism**	*Antibiosis*

***Table 1** – The ecological interaction names.*

Antibiosis is a form of interaction between living holons that is harmful to at least one of them. So, the term covers a broad range of interactions. They include amensalism or competition in which one party is ultimately harmed. They also include conflict in which both parties are harmed. The term antibiosis is also used in a more particular sense to describe a relationship in which chemical substances or wastes produced by one party harm another. So, to describe interactions more specifically, the terms amensalism and conflict will be used rather than antibiosis.

The opposite of antibiosis, symbiosis, will also be replaced by the term mutualism. This results in Table 2 below.

		y		
		+	o	-
x	+	Mutualism	Commensalism	Competition
	o	Commensalism	Neutralism	Amensalism
	-	Competition	Amensalism	Conflict

***Table 2** – Rationalized ecological interaction names.*

C. Symbolising interactions

Basic symbolism

All interactions between living holons are motivated by the acquisition of satisfiers and the avoidance of contra-satisfiers. Effort is required and resources are employed in any interaction. So, net satisfaction or net benefit is the satisfaction gained minus the satisfaction lost due to the effort and resources employed. If net satisfaction becomes negative, then this is equivalent to a contra-satisfier or a net disbenefit.

Conventionally, ecological interactions are symbolised by stating the net benefit or disbenefit of the interaction for each party. For example, where “+” is a net benefit, “–” a net disbenefit, and “0” is no overall benefit or disbenefit, then (+,+) means that there is a net benefit to both parties and (+,-) means that there is a benefit to one and a disbenefit to the other. However, this conventional symbolism does not adequately describe the nature of the interactions, and so, an alternative is proposed.

Interactions take place between two living holons, x and y, who may be species, groups of organisms, or individual organisms. They may also be human or non-human. Finally, one of the two can be the holon’s environment, which, whilst it includes the natural environment, can also be an unspecified party.

The ideal system for describing these interactions would be Symbolic Reasoning. This is because it would permit logical manipulation of the equations describing the interactions. (Challoner, 2022). In Symbolic Reasoning $\mathbf{x}^1 \subseteq (\mathbf{g}\ast\mathbf{s}_1{}^1)\ast\mathbf{y}^1$, for example, means x gives the satisfier s_1 to y, and $\mathbf{y}^1 \subseteq (\mathbf{t}\ast\mathbf{c}_2{}^1)\ast\mathbf{x}^1$ means that y takes the contra-satisfier c_2 from x. However, a simpler form of symbolism that can be translated into Symbolic Reasoning is proposed here. X or x and Y or y represent the two living holons. E or e represents their environment or an unspecified party. The symbol x, when used in isolation, indicates that the holon exists. The absence of another, y, if it has previously been referred to, indicates that it has expired or become extinct.

Interactions can be symbolised by combining two holons, e.g., XY, YX, XE, EX, YE, EY. In each interaction, a satisfier, symbolised by "+", or contra-satisfier, symbolised by "-", is provided by the party on the left to the party on the right. It is the party on the right that benefits from the satisfier or is harmed by the contra-satisfier. The active party in any transfer is symbolised by an uppercase letter, i.e., X, Y, or E. The passive party is symbolised by a lowercase letter, i.e., x, y, or e. Thus, for example, X+y means that x gives a satisfier to y for the benefit of y, and y+X means that X takes a satisfier from y for the benefit of x. Similarly, X-y means that X gives a contra-satisfier to y to the disbenefit of y and y-X means that X takes a contra-satisfier from y to the disbenefit of X. In the text that follows, the expressions "for the benefit of…" and "to the disbenefit of…" will be omitted and, when the reader encounters the words "gives" or "takes", these phrases are implied.

If it is necessary to define a satisfier or contra-satisfier then a subscript letter can be used, e.g., "$+_A$" or "$-_B$". However, for the sake of simplicity, subscripts will not be used here.

If there is no transfer, then this is symbolised "o", e.g., xoy, but again, to simplify matters, this can be omitted. Thus, for example, X+y Yox yoX becomes X+y.

This gives the following range of interactions where X or Y can be replaced by E, and x or y by e:

X+y	X gives a satisfier to Y (for the benefit of Y)	Y+x	Y gives a satisfier to X (for the benefit of X)
x+Y	Y takes a satisfier from X (for the benefit of Y)	y+X	X takes a satisfier from Y (for the benefit of X)
X-y	X gives a contra-satisfier to Y (to the disbenefit of Y)	Y-x	Y gives a contra-satisfier to X (for the disbenefit of X)
x-Y[1]	Y takes a contra-satisfier from X (to the disbenefit of Y)	y-X[1]	X takes a contra-satisfier from Y (for the disbenefit of X)
Xoy	X gives nothing to Y	Yox	Y gives nothing to X
xoY	Y takes nothing from X	yoX	X takes nothing from Y
xoy	There is no transfer between X and Y	yox	There is no transfer between Y and X

***Table 3** – All possible unidirectional interactions between two parties*

Reflexive interactions

A living holon can give a satisfier to itself. This is, for example, symbolised X+x. Theoretically, at least, it can also provide a contra-satisfier to itself, e.g., X-x. An example of this modified symbolism is real altruism, in which x, at its own expense, gives a satisfier to y. This is symbolised X+y X-x.

Abnormal interactions

The interactions, x-Y[1] and y-X[1], in Tables 3 and 4, are abnormal because, if they wish to survive and procreate, it is normal for living holons to avoid contra-satisfiers rather than actively acquire them. (Law C04). For the same reason, it is also abnormal to give a contra-satisfier to oneself. Thus, for example, X-x[2] in Table 4 is abnormal.

Transfers of satisfiers and contra-satisfiers that the source is experiencing

When a satisfier or contra-satisfier is transferred from one party to another, it can either be one that the source also needs or one that it does not. Alternatively, it can be a contra-satisfier that the source also suffers or one that it does not. To show this difference, the effect of the transfer on the source is symbolised, as shown in the following table. The names given to these interactions are also shown in brackets. Ecological names are shown in normal text and sociological names in italics.

Symbolism	Description
X+y	X gives a satisfier that it does not need to Y. (*Biological altruism or Benevolence*)
X+y X-x[2]	X gives a satisfier that it needs to Y. X harms itself in doing so. (*Real altruism and abnormal*)
y+X	X takes a satisfier from Y that Y does not need. (*Harmless acquisition*)
y+X X-y	X takes a satisfier from Y that Y needs. X harms Y in doing so. (Parasitism, Predation and Herbivory)
X-y	X gives a contra-satisfier that X does not suffer to Y. (Direct Amensalism)
X-y X+x	X gives a contra-satisfier that X suffers to Y. X benefits itself in so doing. (Direct Amensalism)
y-X[1]	X takes a contra-satisfier that Y does not suffer from Y. (*No name and abnormal*)
y-X[1] X+y	X takes a contra-satisfier that Y suffers from Y. X benefits Y in so doing. (*Alternative form of real altruism and abnormal*)

Table 4 *– Distinguishing between satisfiers needed or not needed by their source and between contra-satisfiers suffered or not suffered by their source.*

Symbolising power

The relative power of two parties in an interaction can be symbolised x>y if x is more powerful than y, or x<y if y is more powerful than x. If the parties are relatively equal in power, this can be symbolised x=y. However, this latter symbolism is normally omitted.

Interactions as parties to other interactions

One or more of the parties in an interaction can itself be an interaction. For example, (W+v)+y means that the interaction W+v gives a satisfier to y, and (W+v)-y means that the interaction W+v gives a contra-satisfier to y. Note that for y to take a satisfier from an interaction it would need to be the active party in that interaction, e.g., (Y+x)+Y.

On the other hand, X+(W+v) means that x gives a satisfier to the interaction W+v. In other words, x does something to facilitate the interaction W+v. Similarly, X-(W+v) means that x gives a contra-satisfier to W+v, i.e., x does something to hinder the interaction W+v.

Note also that interactions do not have agency, and so, cannot take satisfiers or contra-satisfiers from another party. The expressions x+(W+v) and x-(W+v) would be incorrect, therefore.

Again, real altruism can be used as an example. (X+y)-x means the act of x giving a satisfier to y gives a contra-satisfier to x. Thus, (X+y)-x = X+y X-x.

Beliefs

The symbolism X-y describes a true interaction between x and y. However, both x and y will have beliefs about the interaction that are not necessarily true. Those beliefs can be described in curly brackets to the right of the relevant party. For example, X{V+w}+y{V+w} means that both parties to the interaction X+y believe that V+w.

These beliefs can, of course, be about the interaction that x and y are a part of. If both x and y hold true beliefs about the interaction X-y, then this can be symbolised X{X-y}-y{X-y}. However, because their beliefs match reality, this expression can be simplified to X-y. It is only where beliefs differ from reality that the symbolism in brackets is necessary. Thus, for example, y may hold a mistaken belief about the interaction X-y, for example X{X-y}-y{X+y}, which can be simplified to X-y{+}. This means y believes x to be giving it a satisfier when, in reality, x is giving it a contra-satisfier. Similarly, X{X-y}-y{Z-y} can be simplified to X-y{Z}. This means y believes that z is giving it a contra-satisfier when, in reality, it is x. To give a final example, if a living holon believes that it is taking a satisfier from another party, then it is possible for it actually to be taking a contra-satisfier. This is symbolised by x-Y{x+Y} or, more simply, by x-Y{+}.

The transmission of Information

The transmission of information and misinformation are particularly important in human affairs. Information transmitted is symbolised by including it in curly brackets to the right of the + or – symbol. For example, X+{V+w}y means that x is giving y the information that V+w. Similarly, x+{V+w}Y means that y is taking the information that V+w from x. If the information transmitted, whether true or false, is a satisfier to the recipient then it is preceded by a "+". If it is a contra-satisfier it is preceded by a "-". The simplified symbolism used here can only represent information about interactions. If any other form of information is transmitted, then the appropriate symbolism must be used as shown in the following example: X+{1+1=2}y.

The transfer of information can be combined with beliefs. For example, X{V+w}-{V-w}y{V+w} means that x and y both know that V+w. So, x is knowingly giving the misinformation that V-w to y. Furthermore, y is receiving that information, and it contradicts what he already knows. It is, of course, possible to unknowingly transmit false information. V+w X{U+w}+{U+w}y, for example, means that x is unknowingly giving y false information that U+w, and the correct information would have been V+w.

D. Comparison of ecological and human social interactions

All possible combinations of the interactions given in Table 3 have been considered and are summarized in the table below. These interactions take place in both the natural ecological context and the human social one, and a comparison is made in the table. Each interaction is then discussed in more detail in the sections that follow. Note that the terminology used in each context differs. The terms used in ecology cover a much broader range of interactions than those used in the human social context.

Interactions can be of three types, simple, indirect, and direct.

- Simple interactions are those between one living holon and its environment. Their purpose is to gain satisfiers or avoid contra-satisfiers from that environment. Several living holons interacting independently with their environment without affecting one another are engaging in simple interactions.
- If one living holon interacts with its environment or a third party, and this *does* affect another, then this is known as an indirect interaction.
- Direct interactions, on the other hand, are those in which satisfiers and contra-satisfiers are controlled by the parties in the interaction. If the interaction is direct, then the parties interact with one another by giving or taking satisfiers, or by giving contra-satisfiers.

Symbolism	Type	Human Intraspecific Interaction	Intra- or Interspecific Ecological Interaction
x	-	Expiry	**Extinction**
xoy	-	Separation	**Separation**[4]
xoy	-	Neutralism	**Neutralism**
x+Y	Direct	Harmless acquisition	**Direct Commensalism**
X+y	Direct	Benevolence or Biological altruism	
X+e e+Y	Indirect	Indirect Benefaction	**Indirect Commensalism**
z>x x+Z Z+y	Direct	Redistribution[5]	*None*
X+y Y+x or XY	Direct	Direct Cooperation	**Mutualism**
z+XY[6]	Simple	Simple cooperation to acquire satisfiers	
XY+z[6]	Simple	Simple cooperation to give satisfiers	
XY-z XY+xy [6]	Simple	Simple cooperation to give contra-satisfiers	
Z-xy[6]	Simple	Simple cooperation to avoid contra- satisfiers	
x>y X-y X+y Y+x	Direct	Involuntary Cooperation	
X+y y+X	Direct	Husbandry	
X-y X+x[1]	Direct	Direct spite	**Direct Amensalism**
X-e E-y	Indirect	Indirect Malefaction	**Indirect Amensalism**
X-(Zoy)y	Indirect	Spite by preventing a satisfier from a third party	
X-(Z-y)y	Indirect	Spite by causing a contra-satisfier from a third party	
z+X z+Y	Indirect	Positive Competition to take satisfiers from a third party	**Indirect Competition**
X+z Y+z	Indirect	Positive Competition to give satisfiers to a third party	
Z+x Z+y	Indirect	Positive Competition to receive satisfiers from a third party	
x+Z y+Z	Indirect	Positive Competition to avoid satisfiers being taken by a third party	
z>x z>y Z-x Z-y	Indirect	Positive Competition to avoid receiving contra-satisfiers from a third party	
X-(Zoy)y Y-(Zox)x[3]	Indirect	Negative competition to receive satisfiers from a third party	
X-(Z-y)y Y-(Z-x)x[3]	Indirect	Negative competition to avoid contra-satisfiers from a third party	
X-y Y-x	Direct	Conflict	**Direct Competition**
X-y x+Y	Direct	Resistance	
x>y X-y Y+x	Direct	Coercion	**Coercion**[4]
X-y y+X[2]	Direct	Free riding	**Parasitism**
x>y X-y y+X[2]	Direct	Exploitation	**Predation**
x+Y y+X	Direct	Reciprocal theft	
x>y X-y y+X[2]	Direct	*Impossible*	**Herbivory**

Table 5 *– Summary of interactions and comparison of those in ecology with those in human society.*

Points to note in this table are as follows.

1. In all cases, one of the parties can be replaced by the environment or an unspecified party. For example, x+Y or harmless acquisition can become x+E or harmless acquisition by an unspecified party.
2. In practice, direct amensalism or spite does have benefits to the actor.
3. When the party from which a satisfier is taken needs the satisfier but has no resilience or surplus of it, then the two terms, X-y and y+X, are reciprocals of one another (Law C08).

4. Negative competition occurs in the hope of prevailing, and thus, acquiring a satisfier or avoiding a contra-satisfier.
5. Although separation and coercion do not have specific names in ecology, these interactions have been observed in the natural world.
6. Redistribution appears to be the only human interaction that does not appear in ecology. This form of interaction may have emerged with the human species, therefore.
7. Because these interactions are with the holon's general environment they cannot be described as interspecific or intraspecific.
8. Note that some relationships only become possible when one party has more power than the other. Where the two parties are relatively equal in power, it is abnormal for the one to give a contra-satisfier to the other if the latter is a source of satisfiers. It is also abnormal to give a satisfier to the other party if it is a source of contra-satisfiers. However, this changes when one party is more powerful than the other (Law E01) & (Law E02).

These interactions will now be discussed individually in more detail. Human and non-human examples will be given for comparison. Again, some of the observations in the sub-sections that follow are general rules of interaction. They are repeated in the appendices and the relevant rule number is given in brackets.

E. Extinction

Species become extinct; individual organisms and groups of organisms expire; individual human beings die; groups of humans expire. All these terms have the same meaning. The living holon has ceased to exist. The comparison between ecological processes and human social processes is an obvious one and it is the reasons for death, expiry, or extinction that are of most interest.

F. Separation xoy

Separation describes a situation in which two parties are unable to interact because they occupy different environments. In the natural world, species occupy different niches or different geographies. In human society the different environments can be functional (Law I01), cultural, or geographic.

However, population growth and resource depletion can cause migration, and thus, bring previously separated parties into contact (Law I03).

G. Neutralism xoy

If parties are unable to interact due to geographical or any other form of separation, this is not referred to as neutralism. Rather, it is "separation". Neutralism is a state that exists when parties interact with the same environment to gain its satisfiers or avoid its contra-satisfiers, but not with one another.

Individual organisms within the same species seek to acquire the same existential satisfiers and avoid the same existential contra-satisfiers (Law F03). However, this is not necessarily the case for relatedness and growth satisfiers. For living holons who need the same satisfiers there must be sufficient available for all if their relationship is to be one of neutralism (Law G01). Failing that, their relationship becomes one of indirect competition. This is true of individual humans. It is also true of human groups if those groups have the same culture and function.

Neutralism between different species is possible, although probably rare. For example, some species of Lactobacillus and Streptococcus can coexist without affecting each other either positively or negatively. (Webpage A).

H. Commensalism

In ecology, commensalism is a relationship between living holons in which one party takes or receives food or other benefits from the other without either harming or benefiting the latter. However, in human affairs, it has several different meanings. In sociology, it is used to describe the peaceful coexistence of individuals or groups with different values or customs. In economics it is sometimes used to describe cooperation in which both parties benefit. Finally, it can be used to mean eating together at the same table. Here, however, the term is used in its ecological sense even when applied to human society.

Commensalism can be regarded as direct or indirect. These two forms will be discussed in the sections that follow.

I. Direct commensalism

A direct commensal relationship is one in which one party benefits by taking or receiving something controlled by another, but this is neither to the benefit nor disbenefit of the latter. Direct commensalism takes two forms: harmless acquisition; and benevolence or biological altruism.

There are always direct commensal interactions between a living holon and its environment (Law C06). The table below provides examples.

Symbolism	Rule	Examples
x+E	All living holons have satisfiers taken from them by their environment. (*Harmless acquisition by an unspecified party.*)	Being observed by others.
e+X	All living holons take satisfiers from their environment. (*Harmless acquisition from an unspecified party.*)	Water.
E+x	The environment gives satisfiers to all living holons. (*Biological altruism from an unspecified party.*)	Sunlight, air, etc.
X+e	All living holons give satisfiers to their environment. (*Biological altruism to an unspecified party.*)	Useful waste products.

Table 6 *– Examples of interactions between a living holon and its environment.*

In some cases, group cooperation is necessary to acquire a satisfier from the environment. For example, water is an environmental satisfier for people, but cooperation is often necessary to ensure supplies (Law H04).

Harmless acquisition y+X

Harmless acquisition occurs when one party takes a satisfier from another without either benefitting or harming it except in a negligible way.

(Webpage J) cites several examples of harmless acquisition in nature. They include orchids growing in the branches of trees. The orchids acquire a habitat at no advantage or detriment to the trees. There are also several examples of one species acquiring transport from another: sharks and remora fish; beetles and pseudoscorpions; animal fur and burdock seeds; whales and barnacles; sea cucumbers and emperor shrimp.

In human affairs, harmless acquisition occurs when one party takes a satisfier from another and the latter has more than necessary to satisfy the needs of themselves and their dependents. It can, for example, occur when a child suckles from its mother.

Benefaction or biological altruism X+y

Altruism is an interaction in which satisfiers are under the control of one party, the altruist, who gives them to another party, the beneficiary.

There are two forms of altruism: real altruism in which the altruist suffers a disbenefit from the altruistic act, and biological altruism in which he does not. However, it is abnormal for a living holon to actively take or give itself a contra-satisfier if it wishes to survive and procreate (Law C04). So, the existence of real altruism is highly controversial. Biological altruism will be discussed in this section and real altruism in the next.

The evolutionary explanation for biological altruism was provided by the British evolutionary biologist, W.D. Hamilton. Hamilton argued that rather than being driven to reproduce their entire genetic code, which is impossible in the case of sexual reproduction, organisms were driven to behave in a way that would enable the survival of closely related genomes. Thus, although people act primarily in their self-interest, they also act to protect their closest relatives, such as children, parents, and siblings. Less commonly, they act to protect more distant relatives such as cousins, aunts, and uncles, because the latter share some of their genes.

This concept is known as inclusive fitness. An explanation of the development of “Inclusive Fitness Theory from Darwin to Hamilton”, by Lee Alan Dugatkin, is given on (Webpage E). Inclusive fitness is apparent in human society but not necessarily to the exclusion of real altruism. (Law D02) Hamilton expressed inclusive fitness in the form of the equation, now known as Hamilton’s rule, i.e., $r \times b > c$. In this equation c, the cost of altruism to the altruist, must be less than b, the potential benefit to the beneficiaries, multiplied by r, the probability of that benefit occurring. (Hamilton, 1964)

To quote from an article on the British Psychological Society’s website (Webpage F): “Simplifying rather crudely, if an altruist can obtain benefits from improving another’s welfare that are not outweighed by personal costs, it is in the altruist’s interest to help and they will tend to do so (Dovidio et al., 1991). The most important components of this calculation are the costs and benefits to the altruist because of changes in the welfare of the person cared about, and the costs and benefits to the altruist of personally providing help to bring such changes about (for a review, see Piliavin et al., 1981).”

In summary therefore, biological altruism is a form of cooperation but one in which the benefits to the altruist are negligible, less than those to the beneficiary, but not to the extent that the altruist experiences a net disbenefit. It can therefore be symbolised X+y.

Examples of biological altruism are given by (Webpage K) as follows. “…vampire bats regularly regurgitate blood and donate it to other members of their group who have failed to feed that night, ensuring they do not starve. In numerous bird species, a breeding pair receives help in raising its young from other ‘helper’ birds, who protect the nest from predators and help to feed the fledglings. Vervet monkeys give alarm calls to warn fellow monkeys of the presence of predators, even though in doing so they attract attention to themselves, increasing their personal chance of being attacked. In social insect colonies (ants, wasps, bees and termites), sterile workers devote their whole lives to caring for the queen, constructing and protecting the nest, foraging for food, and tending the larvae.”

Biological altruism can take the form of communication which, while it exists in nature, is particularly important and highly developed in human society. Information is infinitely replicable, and one party can pass a copy to another whilst retaining the original (Challoner, 2023). Thus, providing the information is true, the recipient can benefit. The provider on the other hand suffers no disbenefit and may even benefit indirectly from the act, as described by Hamilton. Altruistic acts also inspire trust in the recipient, i.e., the belief that the altruist has a cooperative attitude, and so, facilitate cooperation between the parties (Law J01).

The transmission of information can take two forms: direct and indirect. Direct transmission is between the provider and the recipient as described above, i.e., X+y. Indirect transmission is via something in the environment such as a book. The latter can be indirect commensalism, i.e. X+e e+Y, and is described in that section.

Not every transfer of information is altruistic, of course, and it is often something that people provide in return for a benefit to themselves, e.g., a fee or advertising revenue.

Finally, information can, of course, be erroneous or deliberately falsified, and thus, can be harmful to the recipient. The simplified symbolism used here applies only to true information from which the recipient benefits. However, using the symbolism described earlier, it is also possible to express the transmission of false information or information that causes harm to the recipient.

Real altruism X+y X-x or y-X X+y

Altruism is defined in the Cambridge English dictionary as a “willingness to do things that bring advantages to others, even if it results in disadvantage for yourself”, i.e., X+y X-x. In this form, it is known as real or psychological altruism. An alternative form of real altruism occurs when one party takes a contra-satisfier from another that the latter is experiencing. In effect, this provides a satisfier to the latter at the expense of the former and so is symbolised y-X X+y. Thus, were it to exist, real altruism would not be classified as commensalism. Rather, both forms would be classified as abnormal.

There are three reasons to believe that what may appear to be real altruism is, in fact, biological altruism.

Firstly, if an altruist controls more of a satisfier than necessary to satisfy his needs and those of his dependents, then he is resilient in that satisfier. So, if some is given to another party, he experiences negligible disbenefit and in effect, therefore, is engaging in biological altruism X+y. An example, is the benefaction of billionaires.

Secondly, some of the benefits to the altruist may not be obvious. For example, the actions of the altruistic billionaire, the adoption of children, and the provision of information to another party appear to have no immediate benefits in terms of propagation of the genome. However, they do have benefits in terms of relatedness which can indirectly benefit genome propagation through community support.

Thirdly, in the case of humans, culture plays a significant role. Through a process of feedback, altruistic behaviour can steadily increase (Law Q14). The process is as follows:

a) The more people there are who behave altruistically, whether this is real or biological altruism, the more beneficiaries there are(Law Q14a), the more society socializes its members to value altruism (Law Q14b), and so, the more people there are who behave altruistically (Law Q14c).
b) The more people there are who behave altruistically, the greater the altruism of the culture of which they are a part (Law Q14d), the greater the safety this culture offers against misfortune, the greater the satisfaction of the human need for security (Law Q14e), the greater the reduction in the cost of behaving altruistically (Law Q14f), and so, the greater the number of people who behave altruistically (Law Q14g).
c) There will of course be free riders, i.e., those who accept the benefits of altruism but do not reciprocate (Law Q14h). However, as beneficiaries, they will encourage altruism (Law Q14i).

> Societies also impose penalties for free-riding, and so, free-riders disguise their behaviour (Law Q14j). Thus, a negative feedback loop that diminishes altruism is avoided.

Nevertheless, it is possible that real altruism may have evolved in humans. If so, there would need to be a gene or set of genes that increases our general level of altruism, such as those that increase our general level of empathy. These would, of course, increase the level of altruism towards our children and close relatives, thereby increasing the likelihood of those genes being propagated.

J. Indirect commensalism X+e e+Y

Indirect commensalism occurs when one party engages in some activity or generates some waste that impacts on its environment in a way that benefits some other party.

Examples in nature include: cattle egrets that feed on insects dislodged by grazing cattle; birds that feed on invertebrates fleeing army ants; arctic foxes that feed on mammals exposed from beneath the snow by grazing caribou; hermit crabs that use the shells of dead snails; and dung beetles that feed on the dung of other animals.

Indirect commensalism exists in society in the form of communication. It occurs when one party places information in its general environment and another party benefits by taking it from there, i.e., X+e e+Y.

K. Redistribution z>x x+Z Z+y

Redistribution occurs when a third party takes satisfiers under the control of one individual or group and gives it to another. Highly developed cognitive skills are necessary for this interaction, and redistribution probably first emerged in humans, therefore. Thus, it appears to occur only in humans and not elsewhere in nature, except possibly in very minor ways.

Power is a measure of the control of satisfiers and contra-satisfiers, and so, the redistribution of the latter can be regarded as the redistribution of power. It is necessary therefore for the party who carries out redistribution to have greater power than those from whom the satisfiers are taken. Thus, a hierarchy is also necessary in addition to cognitive skills.

Money is a general satisfier in the sense that it can be traded for any other satisfier. It is mainly money, therefore, that we redistribute. An example is the taxation of a nation by its government, to provide common services such as healthcare, education, public transport, infrastructure, etc., for those who need them.

Although redistribution is a human activity, we do not do it particularly well. It is undermined by the personality traits, values, beliefs, and behaviours of the redistributors. These can include self-interest, corruption, dark traits, ideologies, etc. It is also undermined by misinformation and the sheer complexity of the task.

Because of its complexity, redistribution is the subject of much ideological debate and forms the basis of politics, therefore. There are different approaches to redistribution, including the extent to which it should take place, how it should be implemented, and how it should be policed.

A process of cultural evolution centered on redistribution is in progress. The driver is indirect competition between nations and the process comprises innovation, trial and error, propagation of the most successful methods, and expiry of the least successful (Law Q17). So, although redistribution has occurred on a relatively small scale since pre-history, the high levels that we see in the world today have only evolved relatively recently.

L. Mutualism

Mutualism can also be described as cooperation. If two or more living holons cooperate to acquire common satisfiers or to avoid common contra-satisfiers, then they exchange satisfiers between themselves, thus forming a new living holon with its own identity in which a control component emerges. Cooperation can be vertical, i.e., an exchange of satisfiers between holons at different levels in a hierarchy, or it can be horizontal, i.e., an exchange of satisfiers between holons at the same or similar levels in a hierarchy. It is not necessary that every pair of component holons cooperate horizontally and exchange satisfiers with one another. However, they must cooperate vertically, either voluntarily or involuntarily, and exchange satisfiers with the control component or leader. This often takes the form of information flowing upwards and instructions flowing downwards (Law B03). Cooperative groups comprise components with a common purpose and, particularly in humans, occur at various levels, e.g., familial, organisational, national, or international. Similarly, when voluntary or involuntary vertical cooperation between individuals in a species occurs, they become a pack or herd, and thus again, a single entity. So, if two living holons, x and y, cooperate in this way, they can be symbolised xy or, more simply, w. This entity then interacts with others in the same way as an individual.

Cooperation will of course fail if it does not lead to the desired result (Law J02). We tend to focus on our failures, and this obscures the fact that human beings are extraordinarily cooperative. Were this not the case then our societies which comprise millions of people, and sometimes even billions, would collapse.

(Webpage L) describes human cooperation in more detail. Examples of cooperation in nature can be found at (Webpage B & Webpage C).

Cooperation can take several forms:

- to take satisfiers from a third party, i.e., z+XY;
- to give satisfiers to a third party, i.e., XY+z;
- to give contra-satisfiers to a third party, i.e., XY-z XY+xy;
- to avoid contra-satisfiers from a third party, i.e., Z-xy;
- to exchange satisfiers, i.e., X+y Y+x;
- involuntary cooperation in which cooperation is enforced by one of the parties, i.e., x>y X-y X+y Y+x; or
- husbandry in which one party gives satisfiers to and also takes satisfiers from another, i.e., X+y y+X.

One party, x, y or z, can of course be replaced by an unspecified one, e.

Those who cooperate are more likely to gain satisfiers or avoid contra-satisfiers, and so, are more likely to survive and procreate. Thus, there is a positive evolutionary feedback loop which strengthens the tendency to cooperate (Law Q11).

Simple cooperation to acquire satisfiers z+XY

This occurs when two or more parties act together to acquire a mutual satisfier. For example, the American badger and coyote hunt together co-operatively (Ojalehto et al, 2015); ravens guide wolves to their prey; honeyguides, which are birds found in Africa and Asia, deliberately lead people to beehives so that they can eat the grubs and wax left behind; many predators hunt in packs; and ants build nests together.

The classic example of human cooperation to acquire a satisfier appears in team sports where team members act together to win the game. However, cooperation to acquire a satisfier occurs in almost all human organisations, not only businesses. The extent to which people cooperate to achieve a common goal is so prevalent that we often fail to notice or acknowledge it.

Simple cooperation to give satisfiers XY+z

This is, in fact, a variation on altruism in which two or more parties cooperate to give a satisfier to a third. This can be seen if the individuals X and Y are replaced by the group W. XY+z then becomes W+z. As mentioned above, altruism can be biological, in which case the expression is XY+z, or it can be real in which case it is XY+z XY-xy.

This form of biological altruism can be seen in the individual cells of every organism. They cooperate to form the organism, but only a few involved in reproduction pass on their genes. In human society a group of volunteers may, for example, work together to set up a food bank.

Simple cooperation to give contra-satisfiers XY-z XY+xy

This is a variation on direct amensalism or spite in which more than one party cooperates to give a contra-satisfier to a third. Again, this can be seen if the individuals X and Y are replaced by the group W. XY-z XY+xy then becomes W-z W+w.

In nature, seals have been known to band together to chase great white sharks from their breeding grounds. In human society we do, of course, create armies to deter aggression by other nations. They pose a threat to the other party who may either flee or avoid their territory.

Simple cooperation to avoid contra-satisfiers. Z-xy

Cooperation occurs principally when living holons face a common threat, i.e., Z-xy. For example, some ants use swarming tactics to protect their nests; ostriches and zebras form packs for protection from predators; gobies and pistol shrimps share a burrow excavated by the shrimp. The goby signals when it is safe to leave. (Webpage B)

People also cooperate in the face of a common enemy or threat as demonstrated by Muzafer Sherif and colleagues in their Robbers' Cave Experiment. (Sherif et al, 1961). In this experiment two groups of children, previously hostile to one another, cooperated to resolve the problem when their water supply failed.

Direct cooperation X+y Y+x

Direct cooperation occurs when each party controls a satisfier needed by another and they exchange or trade these satisfiers to their mutual benefit. This can result in co-evolution, in which the parties become increasingly dependent on one another (Law Q11).

In the natural world, apes groom one another to remove parasites. Flowers provide nectar for bees to feed upon and in return the bees pollinate the flowers. Aphids secrete honeydew consumed by ants and the ants protect the aphids from predators and parasites. Cleaner fish in coral reefs receive and inspect other fish. Some Galapagos finches consume parasites from iguanas and giant tortoises. Corals and algae produce nutrients for one another. (Webpage B)

This form of cooperation is prevalent in human society and takes the form of trade or exchange. However, we now use money, a general satisfier, in one part of the exchange to extend our cooperation beyond the limits of direct barter.

Involuntary cooperation x>y X-y X+y Y+x

Involuntary cooperation occurs when one party has more power than the other and forces an exchange of satisfiers. It differs from coercion, in which the coercer benefits and the victim suffers disbenefits.

Involuntary cooperation is relatively rare in nature and the only known examples are client fish punishing cleaner fish who cheat, and male cleaner fish punishing females who cheat. (Raihani et al, 2012)

In human society, an example is local government taxation in return for services such as waste collection, road maintenance, etc. If this were a voluntary arrangement, many would be unwilling to pay. They would free ride, and this would be to the detriment of all. So, there is a legal obligation to pay and penalties for not doing so. In return, we have our bins emptied and roads maintained. Another example is countries that draft citizens into the armed forces. Again, many draftees are reticent and there are legal obligations, but the draftee receives pay, training, food, accommodation, etc., in return.

Husbandry X+y y+X

Husbandry occurs when one party provides satisfiers to another but also takes satisfiers from it. In human affairs, for example, good management, bee keeping, and farming involve husbandry. In nature, leaf cutter ants use their leaves to farm a species of fungus that they feed to their larvae.

M. Direct amensalism or spite X-y X+x

Direct amensalism is also commonly known as spite. Spite is defined in the Cambridge English dictionary as intentionally annoying, upsetting or hurting someone. It occurs when one party in control of a contra-satisfier imposes it on another, i.e., harms them, without necessarily benefitting from it.

In practice, however, there are benefits to spiteful behaviour, although they may be minor. This was discovered by George R. Price, a friend and colleague of W. D. Hamilton, who improved on Hamilton's theory with a more complex statistical equation of much broader application. Interestingly, this equation also provides support for the existence of group selection (Webpage G). Price found that harming those that are not closely related results in an increase in the probability of one's genome being passed onto future generations. So, spiteful behaviour should be symbolised X-y X+x, rather than just X-y.

To give an example, many animals covertly kill the young offspring of other members of their species. (van Schaik & Janson, 2000). Tuberculosis-infected European badgers and rabies-infected dogs tend to emigrate from their usual territories to those of others before starting to distribute the pathogens. (Jog & Watve, 2005).

Others who are not the target of spiteful activity may regard it as a contra-satisfier or threat to themselves and may cooperate to avoid it or eliminate it (Law K06).

Contra-satisfiers for a living holon from its environment are universal, i.e., they always occur. (Law C06). The table below demonstrates this.

Symbolism	Rule	Examples
E-x	The environment gives contra-satisfiers to all living holons. (Spite by an unspecified party)	Floods, earthquakes, etc.
X-e	All living holons give contra-satisfiers to their environment. (Spite to an unspecified party)	Pollutant wastes.

Table 7 *- Examples of amensal interactions between a living holon and its environment.*

In some cases, group cooperation is needed to avoid a contra-satisfier. For example, it is often necessary for groups to construct defenses against natural catastrophes such as floods (Law H04).

If a contra-satisfier due to direct amensalism persists but does not cause the demise of its target, then those that are more able to avoid it are more likely to survive and procreate. Thus, victims of direct amansalism will evolve so that they prevent the aggressor from causing their death or failure to procreate. (Law Q08)

N. Indirect amensalism

Indirect amensalism occurs when one party causes harm to another via a third party or the environment. It can take three forms:

- indirect malefaction, i.e., X-e E-y;
- spite by preventing a satisfier from a third party, i.e., X-(Zoy)y; and
- spite by causing a contra-satisfier from a third party, i.e., X-(Z-y)y.

Indirect malefaction X-e E-y

Indirect malefaction is involuntary and occurs when one living holon acts on its environment or passes a waste or chemical secretion to it that harms another. Thus, the latter cannot exist or thrive in the presence of the former. Indirect malefaction has no apparent cause and is merely a consequence of the existence and normal activities of a living holon (Law P01).

When one party passes a waste or chemical to its environment that harms another, this is known as antibiosis. The Encyclopedia Brittanica states that “The classic demonstration of antibiosis is the destructive effect that the bread mold Penicillium has upon certain bacteria; the secretion, known as penicillin, has become a potent medicine in combating bacterial infections. Some higher plants secrete substances that inhibit the growth of—or kill outright—nearby competing plants. An example is the black walnut (Juglans nigra), which secretes juglone, a substance that destroys many herbaceous plants within its root zone.”

Humanity does of course pass pollutants to its environment with little concern for the consequences. These pollutants cause harm to many other species, and also to other members of society.

If a contra-satisfier experienced as a result of indirect malefaction affects the existence or procreation of the recipient, then that latter will expire or die, i.e. X-e E-y → X-e (Law P03)

Spite by preventing a satisfier from a third party X-(Zoy)y

Indirect spiteful acts have the advantage that they can be carried out more covertly than direct spiteful ones. Thus, they are less likely to lead to conflict. Misinformation plays an important part in indirect spite, and so, it is mainly a human practice.

An indirect spiteful act can occur if another party has a satisfier that the spiteful actor also wants. The actor will attempt to influence the third party who is providing the satisfier to the competitor so that it no longer does so, i.e. Z+y → X-(Zoy)y (Law K03). It can also occur when there is a contra-satisfier in the environment or controlled by a third party that cannot be avoided by all. If one party believes that it is losing in positive competition to avoid the contra-satisfier then it will attempt to prevent the other from avoiding it by influencing the environment or third party (Law K04).

It can also occur if the spiteful actor feels it is unlikely that he will gain a satisfier through positive competition (Law K02).

Unless an indirect spiteful act is carried out covertly or the actor quickly prevails, the target is likely to reciprocate, leading to negative competition, i.e. X-(Zoy)y → X-(Zoy)y Y-(Zox)x (Law L01).

Spite by causing a contra-satisfier from a third party X-(Z-y)y

If another party is avoiding a contra-satisfier that the spiteful actor also wishes to avoid, then the actor will attempt to influence the third party provider of the contra-satisfier so that it imposes it on the competitor, i.e., Zoy → X-(Z-y)y (Law K05). Again, misinformation plays an important part in this and so this is mainly a human practice.

Again, unless an indirect spiteful action is carried out covertly or the actor quickly prevails, the target is likely to reciprocate leading to negative competition, i.e. X-(Z-y)y → X-(Z-y)y Y-(Z-x)x (Law L01).

O. Indirect competition

Indirect competition occurs when two or more parties interact with the same third party to acquire the same satisfier or avoid the same contra-satisfier. The interactions are described as indirect because there is no direct exchange of satisfiers or contra-satisfiers between the competing parties. There are seven such interactions, each of which can also be described as positive or negative competition. They are:

- Positive competition to acquire a satisfier from a specified party, i.e., z+X z+Y;
- Positive competition to give a satisfier to a specified party, i.e., X+z Y+z;
- Positive competition to receive a satisfier from a specified party, i.e., Z+x Z+y;
- Positive competition to avoid a satisfier being taken by a specified party, i.e., x+Z y+Z;
- Positive competition to avoid receiving a contra-satisfier from a specified party, i.e., z>x z>y Z-x Z-y;
- Negative competition to acquire satisfiers from a specified party, i.e., X-(Zoy)y Y-(Zox)x
- Negative competition to avoid contra-satisfiers from a specified party, i.e., X-(Z-y)y Y-(Z-x)x

The specified party, z, can be replaced by an unspecified one or the general environment, e.

If a satisfier is sufficient for all, then the parties who need it merely interact independently with the source and the relationship between them is one of neutralism (Law G01). However, a population grows until a satisfier needed by it becomes insufficient for all. The relationships between those who need it then becomes one of indirect competition (Law G03). To cite another example, leadership roles, because of the benefits they convey, act as satisfiers. However, such roles are limited and cannot be filled by all. So, they generate competition (Law B06).

Similarly, if common contra-satisfiers do not exist or can be avoided by all parties, then the parties merely interact independently with the source to avoid them and the relationship between them is one of neutralism (Law G02). For example, we can all be careful to avoid accidents when crossing the road. However, as a population grows, the situation may arise in which not all parties are able to avoid a contra-satisfier. The relationship between them then becomes one of indirect competition (Law G03).

When a common satisfier becomes insufficient for two living holons, or a common contra-satisfier cannot be avoided by both, then the relationship between the holons is initially one of positive competition, i.e., both parties do their best to acquire the satisfier without interfering with one another in any way. (Law H01 & Law H03).

Depending on the interaction styles of the competing parties, they then have three options (Law H04).

a) Where feasible, they may cooperate to gain greater mutual access to the satisfier or mutually avoid the contra-satisfier.
b) At any point during competition, as it morphs into conflict, one party can, if possible, move to another geographical location (Law I02) or alter its function. In this way the satisfier may become sufficient for both or the contra-satisfier avoidable by both. In the social context, a change of function that results in a change of satisfiers or contra-satisfiers can be the equivalent of moving to another geographical location (Law I01).
c) The two parties can continue to compete to acquire the satisfier or avoid the contra-satisfier. It is this that can lead to conflict.

Indirect competition can result in some of the parties being unable to acquire a satisfier that has already been fully exploited by others (Law H05). This can lead to amensalism, an interaction in which one party, whilst carrying out its normal function, causes harm to or the expiry of another without any benefit to itself. The latter cannot thrive or exist in the presence of the former.

Indirect competition to acquire satisfiers from an agent can result in the parties providing the controller of the satisfier or contra-satisfier with misinformation. The greater the likely impact of the satisfier or contra-satisfier on the competitors, the greater the probability that they will provide such misinformation (Law K01).

Indirect competition to acquire satisfiers or avoid contra-satisfiers, whether from an agent or not, can result in the parties engaging in spiteful acts intended to hamper the other party (Law K03) & (Law M02).

Those with a greater ability, i.e., fitness, to acquire a satisfier or avoid a contra-satisfier are more likely to survive and procreate than those with a lesser ability. Thus, there is a positive evolutionary feedback loop in which these abilities are progressively developed. The traits exhibited by successful competitors grow ever more predominant, particularly those associated with the selection of partners with whom to reproduce (Law Q08 & Law Q09).

If the acquisition of a satisfier or the avoidance of a contra-satisfier is necessary for existence or procreation, then indirect competition can cause one party to die or become extinct. Thus, for example, x>y z+X z+Y → z+X (Law H07).

Indirect competition to avoid a contra-satisfier can result in some of the parties being unable to avoid it. Thus, for example, Z-x Z-y → x Z-y (Law H06).

Positive competition to take satisfiers from a third party z+X z+Y

Positive competition to take satisfiers occurs when a satisfier in the environment or controlled by a third party is not sufficient for all. Each party does its best to obtain it, leaving others to fend for themselves.

Examples in the natural world include Wolf spiders, who are not involved in any confrontation, but as their population increases the availability of food decreases until only the spiders most capable of catching it survive. There are also many examples in which an invasive species competes with a native one for space or other satisfiers, and in which one ultimately prevails. Examples include red and grey squirrels and black and brown rats in the UK. Co-existing groups and species also compete with one another when resources are scarce. For example, insect colonies of the same species compete positively for food. Herds of zebras and gazelles compete positively for grass.

In nature, positive competition can affect population size. For example, when one species of salamander in the Great Smoky Mountains of the eastern United States is removed, the other's population grows in size and vice versa (Webpage C).

In human society, competitors recognise a source of satisfiers and compete to control it. For example, similar businesses compete for the same customers via advertising.

If the third party has agency, then positive competition to take satisfiers can result in conflict between each party and the third party, i.e., z+X z+Y → Z-x X-z Z-y Y-z (Law H09).

Positive competition to give satisfiers to a third party X+z Y+z

This form of competition is proactive. Competitors do not interact with one another. Rather, they recognise a third party as a potential source of satisfiers and compete for a co-operative relationship with it. They compete to offer the best satisfiers in the hope that the third party will reciprocate. This form of interaction can only be described as positive competition if the third party does not have sufficient satisfiers to enter into a co-operative relationship with all competitors. This interaction normally results in the competitor with greater power entering into a co-operative relationship with the third party, and the other failing to do so, e.g., x>y X+z Y+z → X+z Z+x (Law H12). In practice, the unsuccessful party has employed resources in attempting to gain the satisfier, and so, experiences a net disbenefit.

In the natural world, for example, a female bird of paradise choses to mate with the male whose display is the most attractive. In human society, parties compete for status in an organisation. However, status has limited availability and is under the control of a third party with even greater status.

Positive competition to receive satisfiers from a third party Z+x Z+y

This form of competition is reactive. A third party indicates a wish to enter into a co-operative agreement with some of the competitors but lacks the resources to do so with all. So, it selects those that display the greatest potential. Thus, positive competition to receive satisfiers controlled by a third party can result in positive competition to give satisfiers to it in the hope of it reciprocating, i.e. Z+x Z+y → X+z Y+z (Law H11).

In nature, some orchids imitate insects to attract pollinators who then attempt to mate with them. In human society, parties compete for jobs and contracts on offer. Other examples include a running race in which the competitors do their best to be first across the finishing line, and football teams that compete to win the match. In both cases a third party, the organiser, benefits and confers awards on the winner.

Positive competition to avoid satisfiers being taken by a third party x+Z y+Z

When the competitors do not have a surplus of satisfiers, positive competition to avoid satisfiers being taken is the same as positive competition to avoid contra-satisfiers. For example, x+Z is the same as Z-x. The latter is described in the section below.

It is only when the two parties have more than enough of a satisfier to satisfy their own needs and those of their dependents that the interaction remains positive competition to avoid satisfiers being taken. In effect, therefore this is competition for the retention of power, i.e. control over satisfiers for others.

An example in human affairs is skill in accounting practices to avoid taxation that a company can afford. In the natural world, this interaction can be seen in animals that farm. For example, ants that farm aphids will protect them from predators even when a limited loss is possible.

Positive competition to avoid contra-satisfiers from a third party z>x z>y Z-x Z-y

Positive competition to avoid contra-satisfiers occurs when a contra-satisfier does not affect all, i.e., there is a limited threat. For example, when a third party with greater power threatens all parties to gain satisfiers but cannot impose the contra-satisfier on all. The parties do not interact with one another. Rather, each does its best to avoid the contra-satisfier, leaving the others to fend for themselves.

If a threat must necessarily have a target, then the source of the threat must have agency. For example, insectivorous birds must feed on some insects (Law H02). Otherwise, it is possible for all parties to avoid the threat and only insufficient fitness in the evolutionary sense will cause them to fail. For example, we can all be careful when crossing the road to avoid accidents.

Misinformation has an important role in this form of competition, therefore. An example in nature is the hoverfly, which while it looks like a wasp to deter predators, has no sting. There are many other examples of such disguises being adopted by insects and plants.

An example in human society is the practice of firing the worst performing 10% of staff in a company each year, as advocated by Jack Welsh, CEO of General Electric until 2001. Theoretically, this practice encourages better staff performance. However, it also encourages the provision of misinformation about their performance.

Positive competition to avoid contra-satisfiers from an agent can result in parties accepting a state of coercion, e.g., z>x z>y Z-x Z-y → z>x Z-x z>y X+z Z-y Y+z (Law H10).

Negative competition to receive satisfiers from a third party X-(Zoy)y Y-(Zox)x

Negative competition to receive satisfiers occurs when there is a scarce resource in the environment or held by a third party that is insufficient for all competitors. Each party does its best to prevent others from receiving the limited resource by influencing the third party so that the satisfier is available to them instead (Law L01).

Negative competition to receive satisfiers normally begins with a spiteful act by one of the competitors, and when this is discovered the other reciprocates. In effect, however, negative competition to receive satisfiers, comprises spiteful acts by both competitors. Negative competition can then escalate into conflict in which the parties directly impose contra-satisfiers on one another (Law M01).

Negative competition to avoid contra-satisfiers from a third party X-(Z-y)y Y-(Z-x)x

Negative competition can also occur when a contra-satisfier does not affect all, i.e., there is a limited threat. Limited threats are normally ones with agency, i.e., there is a threat from a third party. Each party does its best to place others in the way of it by influencing the third party so that it is not affected by it (Law L02).

Again, this form of competition normally begins with a spiteful act by one of the competitors, and when it is discovered the other reciprocates. In effect, however, negative competition to avoid contra-satisfiers, comprises spiteful acts by both competitors. It can then escalate into conflict in which the parties directly impose contra-satisfiers on one another (Law M01).

P. Direct competition

Direct competition is an interaction between two parties. It takes two forms:

- Conflict with a specified party, i.e., X-y Y-x; or
- Resistance to a specified party, i.e., X-y x+Y.

In both cases the specified party, y, can be replaced by an unspecified one, e.

Conflict X-y Y-x

Conflict occurs when the parties in an interaction give contra-satisfiers under their control to one another. In effect it comprises direct amensalism or spite by both parties.

Interspecific conflict in the natural world is rare because different species occupy different ecological niches. However, interspecies conflicts between African elephants, rhinos and members of other species have been observed at waterholes (Webpage I). Also, violent conflict between chimpanzees and gorillas has recently been noted (Webpage H). Intraspecific conflict, on the other hand, is relatively common. Examples are: warring between colonies of Argentine ants (Webpage D); violent conflict for alpha status among male mandrills; and male stags fighting for control of the females in a herd.

Conflict occurs frequently in human society. Individuals, criminal groups, ideological groups, and nations all engage in conflict over power or resources. This conflict can be violent, as in the case of war, or it can be legal, such as when we sue one another.

We can slip into conflict. People do not always behave logically and can irrationally compete when cooperation is the means to success. (Katz, Finestone & Paskevich, 2022) (Law J04).

Positive competition can lead to conflict, and thus, harm to both parties (Law M01). So, it is notable that the parties will often attempt to avoid the latter. At any stage during escalation from positive competition to violent conflict, one party can migrate or change its function (Law I01), and thus, alter the common satisfier or contra-satisfier competed over (Law I02). For example, colonies of Costa Rica's trap jaw ant will flee and resettle elsewhere rather than engage in violent conflict. Honeypot ants will engage in ritualistic rather than real conflict by making displays of size, and those of apparently lesser size normally retreat (Webpage D). Historically, in human affairs, minorities who have suffered persecution have migrated. For example, the migration of religious minorities from Europe to North America. In the social context, a change of function to avoid conflict can be the equivalent of migration (Law I01).

If one holon has a negative interaction style and appears to be losing the competition it can commit an act of indirect spite. This involves preventing the source of the satisfier from delivering it to the other party. For example, by polluting a well or persuading those capable of giving a promotion that the other party is unsuitable. Normally, these are covert actions in the hope that the other party will not discover them (Law K02).

However, if they are discovered then the other party may, but does not necessarily, reciprocate leading to indirect negative competition (Law L01).

If both parties are willing to escalate, then a feedback process occurs. Further escalation can then occur though an act of direct spite in which one party delivers a direct contra-satisfier to the other (Law M01).

It is possible initially for this to be covert and one sided. For example, bands of chimpanzees engage in wars for territory but begin with covert raids in which individuals from the other group are murdered (Law M02).

Once one party, physically imposes a contra-satisfier on another, and this is recognised by the latter, then any threat perceived by the latter becomes real. The latter can, but does not necessarily, reciprocate and the situation becomes one of conflict (Law M03).

Unless there are controls, external or otherwise, a feedback process will occur in which the contra-satisfiers that the two parties impose on one another escalate until the conflict becomes violent (Law M04). This process of escalation can of course be prevented by the attitude of one of the parties or by the intervention of a third party. It can be seen from the above description that there are many ways in which either party, or a third one, can intervene to prevent conflict. This does, of course, require an understanding of the processes involved, and intervention at an early stage before violence becomes inevitable and unpreventable. Unfortunately, it is also the case that parties can intervene to make conflict more likely, and those with beneficial intent must be cognisant of that too.

If one party holds more power than the other, the former will usually prevail. The interaction will then become one of predation, or parasitism. Alternatively, the losing party will be killed or become extinct, i.e., x>y X-y Y-x → X. However, if the parties have relatively equal power, then the conflict persists, and will escalate to the detriment of both (Law M04).

If conflict interferes with the parties' ability to survive and procreate, a positive evolutionary feedback loop develops in which parties become ever more capable of harming their opponent. For example, male stags become ever stronger and armies become ever more skillful (Law Q10).

Resistance X-y x+Y

Resistance occurs when one party tries to take a satisfier from another, and the other resists by giving a contra-satisfier in return.

The classic example of resistance in the natural world is the ability of many organisms to fight bacterial infections. Their immune system attacks and kills bacteria that would otherwise take nutrients from their body and multiply. Their immune system is also capable of "remembering" previous infections and responding more rapidly to recurrences.

In human society, resistance to an invading army is well known. An example is the Maquis in 2nd World War France. Resistance to oppressive governments is also well known. For example, the post-communist colour revolutions of Georgia, Ukraine, and Kyrgyzstan. Less well known, however, is the sociological concept of resistance by a sub-culture to norms and values imposed by a parent one. For example, the resistance of the "greens" to the values and norms of mainstream society.

Resistance by the victim ultimately results in the aggressor either succeeding or failing to take the satisfier from it, i.e., y>x X-y x+Y → x+Y or x>y X-y x+Y → xoy (Law O02).

If an aggressor population takes a satisfier that affects the ability of the victim population to survive and procreate, then, through a process of natural selection, the victim population can develop a resistance. This resistance can result in both biological and cultural change (Law Q08).

Q. Coercion x>y X-y Y+x

Coercion is an interaction in which one party who holds more power than the other gives contra-satisfiers to the latter. It usually takes the form of threats whose purpose is the acquisition of satisfiers.

For example, if the behaviour of a subordinate leader or a child holon does not accord with that of a senior leader or holon, then the latter may attempt to coerce the former (Law N02).

In species with alpha males, such as gorillas, other males generally accept a subordinate role rather than risk conflict. Sexual coercion, particularly, but not exclusively, of females by males is widespread in nature and much studied by biologists (Webpage M and Webpage N).

In an established human hierarchy, individuals will accept a subordinate role rather than risk a loss of livelihood. Sexual coercion also exists in humans in the form of sexual assaults, including rape. (Stamos, 2011)

R. Parasitism X-y y+X

Parasitism occurs when one organism lives on or in another and uses it as a source of food or other satisfier. In the natural world, parasitism is always interspecific, i.e., the parasite species is different to the host species. Most animal species, including humans, act as hosts to parasites. Examples of parasites include worms, leeches, ticks, mites, and lice. Some species of fungi also parasitise animals or plants. Another example, malaria, is caused by single celled parasites of the plasmodium group that are transmitted via mosquito bites.

In human society and groups of social animals, intraspecific parasitism is also possible. Individuals can free ride, i.e., be a member of a group, and take its benefits, but not contribute to it.

If the source of a satisfier needs it and has no resilience in it, then taking the satisfier from it is equivalent to imposing a contra-satisfier on it, i.e., y+X X-y. The same is true when there is no resilience in the environment, i.e., e+X X-e. (Law C08)

If a contra-satisfier, experienced as a result of parasitism, is one affecting the existence or procreation of the host, then that latter will expire or die, i.e., X-y y+X → X (Law P03).

All parasites take satisfiers from their host. If a parasite has no host it will die (Law P04).

Because a parasite that does not cause its host to expire is more likely to survive and procreate, parasites evolve so that they do not cause their host to expire (Law Q15).

Alternatively, a parasite can adapt to provide benefits and reduce disbenefits to its host, and thus, a co-operative relationship evolves (Law Q16).

If a contra-satisfier due to direct parasitism persists but does not cause the demise of its target, then those that are more able to avoid it are more likely to survive and procreate. Thus, hosts will evolve so that they prevent the parasite from causing their death or failure to procreate (Law Q08).

S. Predation and herbivory

Exploitation x>y X-y y+X

Predation or herbivory occur when one party with greater power takes a satisfier under the control of another against the latter's will. If the latter needs the satisfier and has no resilience in it, then this results in a contra-satisfier or harm to them. If the satisfier is necessary for their survival or procreation then this will result in their expiry.

Examples of predators and their prey are given in (Webpage O). They include spiders that prey on insects, dolphins that prey on fish, and the well-known big cats that prey on large herbivorous mammals. Plants too can be predators. For example, the pitcher plant is a predator and insects are its prey. People are of course omnivores, and we consume both meat and plants, although these are now almost entirely farmed.

In human and some animal societies, all forms of exploitation, e.g., theft and murder, are the intraspecific equivalent of predation.

A herbivore is an animal that consumes plants. So, it is impossible for individuals or groups from the same species to have a herbivorous relationship (Law P02).

If the source of a satisfier needs it and has no resilience in it, then taking the satisfier from it is equivalent to imposing a contra-satisfier on it, i.e., y+X X-y (Law C08).

If a contra-satisfier experienced due to predation, or herbivory, is one affecting the existence or procreation of the recipient, then that latter will expire or die, i.e., x>y X-y y+X → X (Law P03).

If the contra-satisfier persists but does not cause the demise of its target, then those targets that are more able to avoid it are more likely to survive and procreate. Thus, co-evolution or an evolutionary arms race takes place between, for example, thieves and victims, herbivores and plants, or predators and prey. A positive feedback loop forms in which, for example, predators become more adept at predation and prey become more adept at avoiding it (Law Q10).

Alternatively, a predator or herbivore can adapt to provide benefits to its target, and thus, a co-operative relationship evolves (Law Q16).

Reciprocal theft x+Y y+X

Reciprocal theft occurs when two parties take satisfiers from one another. For example, in the natural world, squirrels pilfer from each other's food caches (Delgado & Jacobs , 2019). Male satin bower birds engage in the reciprocal theft of feathers and other decorations from each other's bowers (Borgia & Gore, 1986).

In human society, young siblings "borrow" from one another. However, because taking without permission can easily lead to conflict, most of us have learned by adulthood not to engage in this practice. Thus, reciprocal theft in humans is rare. Only unsocialized criminals and criminal organisations engage in this behaviour when they meet one another. Furthermore, most nations have legal sanctions against theft. However, these sanctions are solely a human practice. Our closest relatives, chimpanzees, only punish for personal injustices.

If a living holon needs a satisfier and does not have a surplus of it, then taking the satisfier from it is the same as giving a contra-satisfier to it (Law C08). If this is true of both parties, then reciprocal theft, or x+Y y+X, becomes conflict or X-y Y-x. However, if both parties do not need the satisfier or have a surplus, reciprocal theft remains that (Law J05).

T. More complex interactions

The basic interactions above can combine to form more complex ones. Two examples are given below but there are many more and their identification is important for the development of social systems theory.

Alliance

An alliance is essentially a horizontally cooperative arrangement. Alliances can form when there is positive or negative competition. The two competing parties can enter into horizontally cooperative arrangements with others in order to improve their likelihood of acquiring the relevant satisfier or avoiding the relevant contra-satisfier. The two alliances then become the two competing parties (Law H13).

For example, if three people are competing for the leadership of a group, and one feels that he is likely to be the lowest in the hierarchy which might otherwise develop, then he may ally with the second most likely to succeed, and help the latter to dominance, thereby gaining second position in the hierarchy.

If two competing parties are relatively evenly matched, then a feedback loop can occur in which both parties seek ever more alliances because to fail to do so would be to allow the other party to succeed. The effect is to broaden the competition, and this can cause groups, nations, and even global society to become competitively divided. (Law H14)

Divide and rule

Divide and rule can take place when one party engages in a spiteful act towards a second by causing a third to regard it as a threat. The first party also engages in a spiteful act toward the third by causing the second to regard it as a threat. So, the second and third parties regard one another as threats and may engage in negative competition which can ultimately lead to conflict. This allows the first party to focus on acquiring the relevant satisfier, which is normally a leadership role.

11. Principle 9: The genome/culture isomorphism.

The design of an entity comprises the information necessary to create its physical manifestation. However, according to cognitive physicalist philosophy, information is structured energy or matter, and so, the design itself must have a physical form.

The ability to translate information from one form to another is an emergent property of life and is only possible for living things and some of their artifacts (Challoner 2022). This ability manifests itself in several forms, i.e., in translation from the design of an entity to its physical manifestation, in the reproduction of copies of that design, and in the many ways in which information is translated during communication.

The genome of an organism comprises all genetic information held by it and can be regarded as its design. The phenotype of an organism is its physical manifestation and is determined by the genome, in conjunction with the environment. The genome also determines the nature of the organism's needs for existence and procreation (Law A01).

Culture is also information. It comprises values, norms, beliefs, knowledge, and symbols and is held in the minds of individuals. Values are those things that we hold good or bad; norms are socially desirable, acceptable, or unacceptable forms of behaviour; and symbols are those things, such as rituals, modes of dress, etc., that indicate our membership of a group. In conjunction with the environment, culture determines the nature of society. Thus, the culture of a living holon can be regarded as its design, and the set of behaviours, i.e., society, of that living holon as its physical manifestation (Law A04).

The function of a living holon comprises its outputs as a system. These outputs in turn are satisfiers or contra-satisfiers for other living holons. Function too is information held in the minds of individuals and this is evidenced by the fact that disagreement about the function of a group is relatively common. (Law A05)

12. Factors affecting relationships

A. Similarity of needs

All human holons have the same range of needs. These form a hierarchy with existence needs at the lowest level, relatedness needs at the next level, and growth needs at the highest level. All human holons prioritise their needs in that order (Law F01).

Genome, function, and culture are determinants of the needs of individual people or larger human holons, as described in the table below.

Need	**Determinant**	
	In the individual holon	**In larger holons**
Growth	Genome/Culture/Function	Culture/Function
Relatedness	Genome/Culture/Function	Culture/Function
Existence	Genome	Function

Table 8 *- The determinants of the needs of individual people and larger human holons.*

Suppose that we have two human holons. The more similar the determinants of their needs, the more similar their needs (Law F02). Individual human beings are, of course, genetically very similar, and so, our existence needs are almost identical. The functions of larger human holons or organisations are more diverse, and it is less common for two to have identical existence needs. The relatedness needs of individuals, i.e., how we interact with others, are determined in part by the genome, in part by culture, and in part by function. So, our needs are more diverse. For example, some cultures value the extended family more than others. The relatedness needs of larger human holons are influenced by a combination of the holon's culture and function, and again can be quite diverse. Finally, the growth needs of both individuals and larger human holons are influenced largely by culture and function, but the genome does play a lesser part in individuals. So, these needs can be very diverse indeed.

Nevertheless, the more similar the two holons' needs, the more similar the satisfiers and contra-satisfiers of those needs (Law F03).

Living holons tend to acquire their satisfiers from others with a similar culture. Thus, the closer two holons are culturally, the more likely they are to share the source of a satisfier (Law F07).

Living holons also tend to acquire their satisfiers from sources geographically close to them. Thus, the closer the holons are geographically the less likely it is that common satisfiers will be sufficient for both. Furthermore, the less likely it is that common contra-satisfiers will be avoidable by both (Law F06).

B. Interaction style

Introduction

The determinants of a living holon's needs also affect the way that it acquires satisfiers or avoids contra-satisfiers. In other words, the interaction style of a living holon depends on its determinants, i.e., on its culture, function and, in the case of an individual, its genome.

Interaction styles are predispositions, i.e., they determine the form of behaviour we will adopt when circumstances arise. In practice, the predispositions of holons are often a mix of co-operation, positive competition and negative competition/conflict, each predominating in different circumstances, as shown in the diagram below.

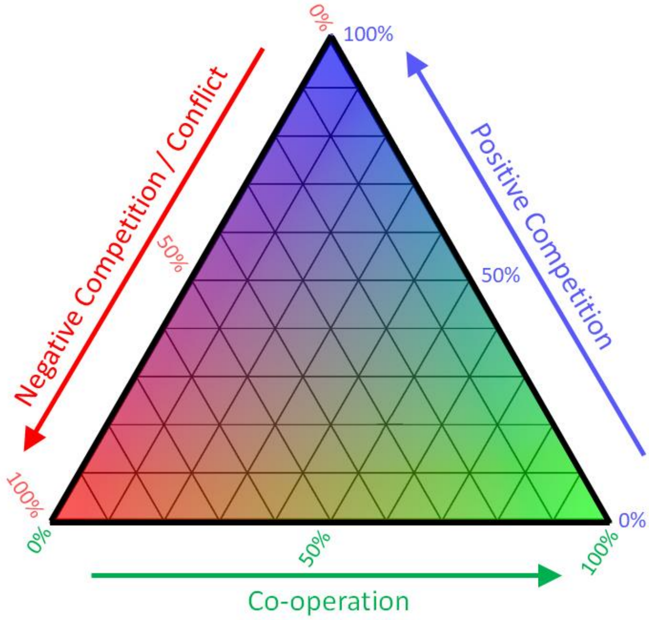


Figure 6 *- Interaction styles can be a mixture of three main dispositions.*

Interaction style is determined by the perception of benefit or threat posed by the other party rather than its actuality. These factors, i.e., interaction style and beliefs about the benefit or threat posed by the other party affect, for example, the likelihood of competition becoming conflict. The more selfish the individual or group and the stronger their belief about the threat posed by a competitor, the more likely it is that they will behave in a way that causes a contra-satisfier or threat to that competitor. Conversely, the more selfless a group and the weaker their belief in any threat posed by the other party, the less likely they are to behave in that way.

Hierarchies

There are two forms of hierarchy in human society. The first is the hierarchy of nested holons, i.e., grandparent, parent, and child holons. The second is the hierarchy of leadership, i.e., directors, senior managers, junior managers, and so on. However, because every holon is ultimately led, either formally or informally, by an individual the two hierarchies are closely related.

Interactions can be vertical, i.e., between holons or leaders above and below one another in a hierarchy. They can also be horizontal, i.e., between holons or leaders at similar levels, but on different branches of a hierarchy. Thus, for example, the interaction between a manager and a junior member of staff is vertical, and the trade between nations horizontal.

Vertical interaction is a special case of interaction in general. True leadership and followership are co-operative, but this form of interaction does not always exist between senior and junior individuals or the components of organisations. A leader must be accepted by followers to gain their willing support. If the leader is appointed by a bottom-up process, i.e., if followers agree their leader, then co-operation will normally ensue. However, if a leader is appointed by a top-down process, then co-operation is not inevitable, and positive or negative competition may occur. An appointed leader and an unwilling follower may, for example, both compete for recognition by a more senior person. Examples of top-down appointments include not only appointments made by senior managers, but also business takeovers and the invasion of nations.

Vertical cooperative interaction style

In the case of vertical cooperative interaction there is a contract or agreement between the two parties. However, the nature of the contract varies on a scale from selfish to selfless. At one extreme is the personal contract, i.e., trading of personal benefits, such as power, wealth, and influence for support. However, Rousseau's social contract states that followers are willing to give up some of their rights in the communal interest (Rousseau, 1762). In essence, this contract states that a follower will support a leader who acts in the best interest of the community. Conversely, the leader will reward a follower who acts in the best interest of the community. However, the definition of "communal interest" can vary, depending on what is regarded as the community. We may, for example, regard it as being our family, our nation, all of humanity, or all of life.

The style of contract sought and offered will depend on the follower or child holon's and the leader or parent holon's attitudes. These, in turn, are based on their genome, on socialization and on experience (Law A02). In general, we place greatest weight on immediate personal interest, but do not neglect our longer-term interests gained communally. The satisfaction we gain from a contract is generally greatest for one that places an emphasis on personal interest and diminishes for those that place an emphasis on social, species, or environmental interest. This decrease is consistent with the multilevel selection theory of evolution. However, this can vary from person to person and holon to holon. An empath, for example, will gain greater satisfaction than average from a contract that places an emphasis on broader community interest, and a psychopath less than average.

Effect of leadership style on interaction style

A leader influences the interaction style of the holon that he or she leads through their leadership style and the culture they promote within the holon. This includes influence over the interaction style of subordinate leaders of child holons. However, the interaction style of any holon is also based on that of previous leaders, the leaders of parent holons, and the interaction style of parent holons. It can therefore be slow to change under the influence of a new leader, particularly if it is distant from him or her.

Frustration

This means that frustration can occur. If holon C is a component of holon B, and holon B is a component of holon A, frustration occurs when an aspect of the culture of holon B contradicts that of holon A. The behaviour of holon C then becomes unpredictable. (Law D04)

Frustration can also lead to coercion. If the interaction style of a subordinate leader or a child holon does not accord with that of a senior leader or holon, then the latter may seek the involuntary vertical cooperation of the former or attempt to coerce them (Law N02). A senior leader or parent organisation is normally in a more powerful position, and thus, able to give threats or more tangible contra-satisfiers to the follower or child holon. Fortunately, extreme examples of such behaviour are now largely illegal, but mild versions persist in many organisations.

Effect of selfishness on interaction style

The more selfish a living holon and the stronger its belief about the threat posed by a competitor, the more likely it is to behave in a way that causes a contra-satisfier or threat to that competitor. Conversely, the more selfless a living holon and the weaker its belief in any threat posed by the other party, the less likely it is to behave in that way (Law H08).

13. Principle 10: The cultural evolution/biological evolution isomorphism.

A. Introduction

The principles of evolution apply only to living things such as bacteria, trees, and people, and their artifacts such as factories and computers. They do not apply to other non-living things. This is because living things and their artifacts are derived from a design which can alter. Other non-living things, such as planets, rocks, etc. may be derived from a design, i.e., the physical rules of the universe, but this does not alter (Law Q01).

Only living organisms and not, for the present at least, their artifacts are capable of self-assembly from their design. In the latter case, an external agent is still needed to carry out the assembly (Law Q01).

What evolves is not the subject but rather its design, i.e., the information that determines how the physical manifestation of the subject is formed. In the case of biological evolution, this design is the genome or genetic constitution of the organism. In the case of cultural evolution, it is, of course, culture. In the case of an artifact, it is literally the design of the artifact as held, for example, in the minds of the organisms, on paper, or on a computer. (Law Q02)

The phrase "cultural evolution" is often thought of as being merely metaphorical. However, very real isomorphisms do appear to exist between biological evolution and cultural evolution. Examples include cultural speciation, cultural co-evolution, sub-cultures vs. sub-species, and so on. More on this topic can be found on the World Values Survey's website at (Webpage Q) and in the excellent book "Cultural Evolution" by Ronald Inglehart (Inglehart, 2018).

The genome of an organism and the culture of a living holon are passed on from generation to generation. To a limited extent, a culture can change during the lifetime of a single generation. However, it is established in early childhood and, although change in later life is possible, for practical biological and psychological reasons, this can prove difficult.

Both biological and cultural evolution have two main components, random mutation, and natural selection.

Random mutation acts on an organism's genome and can, for example, be caused by radiation, viruses, or copying errors during replication. Most random mutations are harmful, a few are neutral, and even fewer beneficial (Law Q04). Random mutations can also occur in culture due to new norms, values, knowledge, ideas, understandings, beliefs, theories, opinions, attitudes, lies, communication errors, changes in the social and natural environment, and even deliberate interventions such as propaganda and advertising (Law Q04). These random mutations can make a living holon either more or less able to acquire satisfiers or avoid contra-satisfiers. Before the advent of the internet, cultural mutations would propagate quite slowly and often die out. However, the internet has subjected society to a form of "radiation" that has accelerated the rate of random mutation enormously. New ideas proliferate and propagate at a rate never seen before. The effect of this has been to accelerate cultural evolution.

It is notable that our interventions have also been biological. We have deliberately intervened in the genome of some organisms via selective breeding and, more recently, direct genetic modification.

Natural selection is brought about by operation of the environment on physical manifestations of the living holon. In the case of biological evolution this was originally the natural environment, but it is increasingly becoming the artificial environment created by human beings. In the case of cultural evolution, whilst this was also originally the natural environment, increasingly it is becoming the social one.

In the case of biological evolution, natural selection operates on the phenotype. In the case of cultural evolution, it operates on larger living holons such as organisations or societies. Under selective pressures from the environment, living holons with harmful mutations often expire or fail to reproduce, whilst those with beneficial mutations tend to propagate (Law Q05). Neutral mutations can persist in a population's genome or culture and can manifest themselves in the form of sub-species or sub-cultures. Later, if the living holon's environment changes, they may prove beneficial or harmful and either propagate or expire (Law Q07).

In principle, cultural mutations that are clearly true and of benefit to society should be selected for by the environment. Others that are neutral should persist, perhaps to come to the fore if the environment changes. Those that are clearly harmful should expire. However, vested interests can influence the propagation of information. This occurred before the advent of the internet when, for example, the Catholic Church supressed scientific discoveries. More recently, commercial and political interests have promoted information on the internet that supports their objectives and have supressed that which does not. To some extent this alters the direction of cultural evolution by accelerating the rate of propagation in some directions, e.g., consumerism, whilst slowing it in others, e.g., environmentalism (Law Q06).

B. The general rules of evolution

Evolution under the effect of contra-satisfiers

When a contra-satisfier that impacts on a living holon's ability to survive and procreate is applied to a population of living holons, then those most able to avoid it are more likely to survive and procreate than those least able. This ability to avoid the contra-satisfier stems from the design of the holon, i.e., its genome or culture. Thus, genetic or cultural attributes that enable avoidance of the contra-satisfier are selected for, and the proportion of those better able to avoid it steadily increases. Advantageous genes or ideas will propagate through the population and disadvantageous ones will expire (Law Q08).

For example, if an aggressor population takes a satisfier that affects the ability of another population to survive and procreate, then, through a process of evolution, the other population can develop a resistance. Through a process of feedback, i.e., the survival and propagation of successful resisters, resistance can result in both biological and cultural change. To cite another example, if a contra-satisfier due to direct amensalism or parasitism persists, but does not cause the demise of its target, then those that are more able to avoid it are more likely to survive and procreate. Thus, hosts will evolve so that they prevent the parasite from causing their death or failure to procreate. Victims of indirect amensalism will do the same.

Evolution under the effect of shortages of satisfiers

When the shortage of a satisfier that impacts on a living holon's ability to survive and procreate is applied to a population, then those best able to acquire the satisfier are more likely to survive and procreate than those least able. Again, through natural selection, the proportion of those better able to acquire the satisfier steadily increases (Law Q09).

Examples - the evolution of cooperation and dark traits

For example, those who cooperate are more likely to gain satisfiers or avoid contra-satisfiers, and so, are more likely to survive and procreate. Thus, there is a positive evolutionary feedback loop which strengthens the tendency to cooperate.

By acting together, it may be possible for more than one holon to acquire a mutual satisfier or avoid a mutual contra-satisfier from the environment. In this way, a cooperative group, and thus, a higher-level holon is formed which follows the same general laws as the original ones. Thus, the higher-level holon can act cooperatively with others to form yet higher-level ones. If holons benefit more, in terms of their survival and procreation, by acting together rather than independently, then the former are more likely to survive and procreate than the latter. So, over time, the genetic or cultural attributes which lead to cooperation will steadily propagate through the population.

Cooperation is the basis of multi-level selection theory, i.e., the survival and procreation of an organism depends on the survival of cooperative groups or holons to which it belongs. Furthermore, multi-level selection theory applies not only to individual organisms but also to higher-level holons. The survival of any higher level holon also depends on the survival of yet higher-level ones to which it belongs. Such holons are formed by their culture, and so, multi-level selection theory also applies to cultural evolution.

The existence of leaders with dark personality traits can also be explained by this process. The lower the level of a holon, the more it contributes to the survival of the organisms that comprise it. Leaders with dark traits may be perceived as beneficial to the survival of the lowest level holon, and thus, the organisms that comprise it, even if this is at the expense of potentially higher level holons. However, evolution cannot predict the future and the highest level holon, humanity, is now at risk from dark leaders. So, such leadership must not be allowed to continue if we are to survive.

The existence of involuntary cooperation may also be explained by this process. People do not necessarily cooperate and can slip into conflict. Thus, being forced to cooperate may be beneficial to their survival. Any genetic and cultural traits that lead to it will therefore propagate.

Competitive co-evolution

It is possible for two populations of living holons to compete to acquire the same satisfier or avoid the same contra-satisfier. In this case, both populations evolve to become ever more capable. Ultimately, one may succeed and the other may expire. But until that time, neither fully succeeds because of the evolution of the other, and ongoing evolution causes the two to become ever more specialised (Law Q10).

For example, in predation what is a satisfier for the predator is a contra-satisfier for the prey. In the case of predation involving two populations A and B, where A provides B with a contra-satisfier, and B provides A with a satisfier, evolution will result in population A becoming better able to acquire the satisfier and population B becoming better able to avoid the contra-satisfier. Thus, co-evolution or an evolutionary arms race takes place between, for example, thieves and victims, herbivores and plants, or predators and prey. A positive feedback loop forms in which, for example, predators become more adept at predation and prey become more adept at avoiding it.

Finally, in the case of conflict, it is possible for the two populations of living holons to provide one another with contra-satisfiers. Evolution will result in both being better able to deliver them, but also in being better able to avoid them.

Cooperative co-evolution

Cooperation comprises the exchange of satisfiers between two parties. If the two parties have different functions, and the receipt of a satisfier from the other party improves their ability to survive and procreate, then cooperative co-evolution will occur. Genetic or cultural traits that better enable one party to acquire the satisfier from the other will propagate through the population. Genetic or cultural traits that enable one party to deliver the satisfier to the other more efficiently, i.e., using fewer resources, will also propagate through the population. Over time, this can result in both parties becoming highly specialised and dependent on one another. The evolution of cooperation is true of both horizontal and vertical cooperation (Law Q11).

Complex evolution

Most actions have both benefits and disbenefits. That is, they yield both satisfiers and contra-satisfiers. Rarely are they entirely beneficial (Law D01). If an action that yields both a benefit and a disbenefit becomes established, and if they affect the ability of the holon or holons that experience them to survive and procreate, then they will become evolutionary drivers for that holon or those holons. If the benefit and disbenefit are both experienced by the actor, then both become evolutionary drivers for that actor. If they apply to different holons, then they become individual evolutionary drivers for those holons. These drivers will cause the benefit to be acquired ever more efficiently and the disbenefit to be avoided ever more effectively. Thus, the holon or holons will become ever more specialised (Law Q12).

C. The consequences of cultural evolution

In living organisms, evolution leads to speciation. Successful genetic mutations accumulate on different lines, and these lines become increasingly different. Initially, they form sub-species that can interbreed but eventually, they become entirely separate species that cannot. The same is true of culture, initially cultural mutations lead to sub-cultures which operate largely within the main one. (Nazari & Belardinelli, 2023). Interaction between the sub-culture and main culture slows the rate of divergence. However, as mutations accumulate, it becomes increasingly difficult for the sub-culture to operate within the main one, and a separation can occur. An example is the migration of religious groups from Europe to the USA (Law Q13).

Such speciation is thought to have occurred in early hominids. The Italian scientist, Fiorenzo Facchini suggests that “Culture probably played a double role in the process of human speciation: (1) in isolation and differentiation from other groups of hominids that did not have such behaviour; and (2) in adaptation to the environment and in communication between groups that had the same cultural behaviour, thus slowing down or preventing the conditions of isolation that lead to new species.” (Facchini, 2006) (Law Q03)

When migration is impossible and a distance between the cultures cannot be achieved, then they will compete, often negatively, as for example in the case of political polarisation in the USA and the Russia/Ukraine war (Law H04).

Finally, in humans, cultural evolution is thought to be a precursor to biological evolution. There may also be an overlap in which both cultural and biological evolution are taking place. This is because different cultures alter their environment in different ways and the environment affects biological evolution. So, if long term geographical separation is possible, then for example, cultural evolution will lead to cultural speciation, which will in turn lead to biological speciation (Law Q03).

14. Practical application of social systems theory

As human society becomes increasingly complex, our mental ability to understand it, predict it, and successfully intervene steadily decreases. To date, there have been no established or agreed formal tools to assist us in our understanding and predictions, or to identify interventions that are technically, economically, and socially feasible. We do, of course, have numerous ad hoc techniques. However, they tend to be informal and based on knowledge gained through experience. The protocol below presents a general formal approach that can be applied to problems of any type, including wars, climate change, and bio-diversity loss. Formalisation also enables the approach to be taught.

As previously explained, the way in which holons emerge and the number of variables in the relationships between them still means that considerable complexity will almost certainly be encountered. Fortunately, we appear to structure society in a way that aids our understanding, i.e., using nested hierarchies of holons and hierarchies of control. This reduces the potential level of complexity. It is further reduced by the fact that interactions between holons at different levels in the hierarchy are much the same for all levels.

The suggested protocol for such modelling is outlined below.

1. **Select modelling medium.** The information provided in this paper enables social systems to be modelled symbolically, graphically, or digitally. The purpose of such modelling is to clarify the relationships between holons, how these relationships can alter with time, and the consequences of any deliberate interventions.
2. **Identify the problem.** The first step is to identify the problem to be solved, i.e., what needs are not satisfied for what holons.
3. **Identify the parent holon.** That is, the holon within which the relevant contra-satisfiers and satisfiers are transferred between components. Examples include a nation, a sector, or a business.
4. **Identify child holons.** Identify the components or child holons. For example, if the problem is international, then the appropriate child holons will be nations. If the problem is national, then the appropriate child holons will be sectors.
5. **Identify interactions between child holons,** i.e., the existence and type of interactions taking place between them.
6. **Identify interactions of the parent holon,** i.e., the existence and type of interactions between the parent holon and others at the same or a higher level. For example, if the parent holon is a sector, these interactions will be with the nation and other sectors.
7. **Identify the needs of each holon,** i.e., their existence, relatedness, and growth needs, and their present state of satisfaction. This will be compared with the situation brought about by a proposed intervention.
8. **Select the modelling approach.** Unfortunately, people are generally unwilling, and sometimes unable to reveal their true behaviour and the reasons for it. This could make them vulnerable to manipulation by others. So, for example, a focus group may not clarify the state of a holon's needs and the nature of its interactions with others. Different modelling approaches are needed therefore depending on the circumstances. These include modelling the existing relationships where possible, historical extrapolation, and iterative random modelling.
9. **Modelling existing relationships.** Where existing needs and interactions are known, they can, of course, be modelled directly.
10. **Historical extrapolation.** If existing needs and interactions are only known to a limited extent, it may be possible to identify them using historical modelling. This would involve creating a model of known past needs and interactions; then to use the rules which describe the ways in which these interactions change over time to predict the present situation. Some needs and interactions will not change over time, and so, this process may also identify those that have existed in the past that also exist in the present. The results should be compared with what we observe today, and the model adjusted as necessary.
11. **Iterative random modelling.** An alternative is, initially, to assume that all needs are satisfied, all horizontal internal interactions are ones of co-operation, and that all vertical internal

interactions accord with the prevailing social contract. Also, it should be assumed, initially, that all information held or transmitted is true. Several instances of the model should then be run with other values of these variables randomly distributed in proportion to their real-world prevalence. Each instance should then be compared with what is known of the present situation. Those that are closest should be selected and the same process followed iteratively until what is known about the present-day situation is accurately represented. This may result in several alternative models.

12. **Objectivity.** Present day models must be built in an objective manner, avoiding any idealism or political correctness. If, for example, corruption or despotism are significant factors, then no benefit will be gained from a model that neglects them. If they exist and are relevant to the problem to be solved, they must be built into the model. Inevitably, however, there will be pressures not to do so.
13. **Select a present day model.** A present-day model can be used to identify the implications of doing nothing and allowing the present situation to continue unaltered into the future. For example, if resources become scarce, then some stakeholders may experience the decline of an important satisfier and will be unable to fully carry out their function. Their reaction may be to seek alternative satisfiers or engage in negative competition for the resource.
14. **Identify general causal trends.** A present-day model is also helpful in identifying general trends and the critical factors associated with them. For example, if a positive feedback loop with no constraints is encountered, then exponential growth can be expected. A negative feedback loop, on the other hand, would lead to exponential decay.
15. **Extrapolate present day model.** Apply the laws of interaction to the present-day model to determine how the situation may develop. There may be several options, and these can help in identifying potential interventions.
16. **Identify critical holons**. In designing interventions, the first stage is to Identify any holons whose interactions are critical to solving the problem. Any critical information which must be true should also be identified for the same reason.
17. **Model critical holons.** The next stage is to model critical holons in more detail at the next level down. For example, if a sector is critical, then consider its component organisations. Again, historical extrapolation or iterative random modelling may be required. This process should be repeated until it reaches the level of individual people, if necessary.
18. **Identify potential interventions as very general concepts.** Social problems are usually either the existence of contra-satisfiers or of insufficient satisfiers. So, the focus of solutions should be on preventing contra-satisfiers and providing adequate satisfiers.
19. **Identify the stakeholders for each intervention.** These will be any parent, sibling, or child holons affected, either positively or negatively, either directly or indirectly, by the existing problem and the potential intervention. All holons are inter-related and cannot be considered in isolation, so theoretically, all will be affected. However, for practical reasons, a cut-off point must be defined. It is suggested that this be when the impacts of the intervention would be so minor that they would not motivate any action by the holon. Conversely, when one holon is particularly severely affected by a problem or potential intervention, then it is appropriate to treat its component or child holons as stakeholders. Nevertheless, the number of stakeholders involved can be substantial. Neglect just one significantly affected stakeholder and unintended consequences can occur.
20. **Consult the stakeholders for each potential intervention.** Successful interventions must not only be viable technically and economically, but also acceptable to the stakeholders. When the latter is ignored, even the best economic and technical solutions can fail to be implemented, or unanticipated social consequences can arise. Each stakeholder will carry out a subjective

form of risk benefit cost analysis before supporting or opposing an intervention. If there is a net benefit to a stakeholder, then they will usually support it. If there is a net disbenefit, they will usually oppose it. Their reactions will often reveal whether they regard each option as a satisfier or a contra-satisfier and for what needs. This would provide useful information should a review or revision of the options become necessary.

21. **Investigate anomalous responses.** Unfortunately, stakeholder representatives can prioritise personal benefits or disbenefits for themselves or their leaders over broader interests. So, for example, what may appear to be a satisfier for a stakeholder organisation may, in fact, be opposed. In these circumstances broader stakeholder representation should be sought.
22. **Model the most acceptable interventions in detail.** Once the social acceptability of each potential intervention has been clarified, model the most acceptable ones in greater technical and economic detail. This should include control measures to prevent critical roles from being occupied by inappropriate individuals, and any critical information from being falsified. For example, national leaders should not engage in relationships based on a personal contract. However, to permit cultural evolution and avoid stagnation, non-critical roles need not be controlled in this way.
23. **Identify the net benefit or disbenefit of each potential intervention for each stakeholder**.
24. **Identify mitigation measures for any stakeholder that will suffer a disbenefit.**
25. **Identify the net overall benefit or disbenefit of each intervention option,** i.e. the aggregate of the benefits and disbenefits for all stakeholders. It is worth putting effort into identifying an intervention that will provide a net benefit for all. However, if this is impossible, then the option that provides the greatest overall benefit, including mitigation measures for those who may suffer a disbenefit, should be sought.
26. **Identify the preferred intervention.** The reasons for this preference will need to be explained to the stakeholders.
27. **Consult the stakeholders on the potential detailed options**. An iterative approach may be required in which options are revised and refined.
28. **Implement the preferred intervention.**
29. **Carry out continuous monitoring.** Because intervention in, for example, one uncontrolled feedback loop can set the conditions for others to develop, the latter may also require intervention after a time. Furthermore, overshoot can occur, and an intervention can create new difficulties, unless it is rolled back once an optimum is reached.

Further development of this formal approach is needed, however. This includes:

- Research into more complex causal relationship patterns and their implications.
- Research to enable the quantification of models where possible. Social systems models are generally qualitative rather than quantitative. It may, however, be possible to quantify some of a model's variables so that the relationships between them can be expressed mathematically.
- Social systems models generally comprise logical relationships. However, it is theoretically possible to include probabilistic relationships. For example, "if a water shortage is likely, then consumers will fill containers". This would reflect human behaviour more accurately than a purely quantitative model.
- The inclusion of other significant ecological factors in the models, such as flows of energy and materials.
- The inclusion of other significant psychological factors, such as denial and other defence mechanisms.

15. Appendix A – Laws

A. Laws of Genetics, Culture, and Function

Law A01: Determinants of the phenotype. The phenotype of an organism is determined by the genome, in conjunction with the environment. The genome also determines the nature of the organism's needs for existence and procreation.

Law A02: Leadership is a determinant of culture. The culture of a human holon is determined largely by its control component or leadership and its parent holon. Leaders' attitudes lie on a scale from entirely selfish to entirely selfless. This is influenced by their personality traits, which in turn are influenced by their genome and upbringing. Greater empathy leads to greater selflessness. Dark traits, such as those held by narcissists, psychopaths, and Machiavellians, lead to greater selfishness.

Law A03: Socially transmitted information is a determinant of culture. A human holon's culture is also determined by the social transmission of information and the reinforcement of beliefs by socialisation, i.e., reward for compliance and censure for non-compliance. The information gained from physically observing something is normally true, although it is possible to misinterpret observed events. However, socially transmitted information can be true or false.

Law A04: Determinants of society. The set of behaviours, i.e., society, of a living holon is determined by the culture of that holon, together with its environment. The culture of a holon can be regarded as its design.

Law A05: The function of a holon is a determinant of behaviour. The function of a living holon is information held in the minds of individuals and is also a determinant of the behaviour of the holon. This is evidenced by the fact that disagreement about the function of a group is relatively common. Function comprises the holon's outputs as a system. These outputs in turn are satisfiers or contra-satisfiers for other living holons. Function is also a determinant of the holon's needs.

B. Laws of Holon Formation

Law B01: Human holons. Human holons are a subset of animal holons. Animal holons are, in turn, a subset of living holons.

Law B02: Control components. Every animal and human holon has a control component.

Law B03: Vertical cooperation is necessary to form a holon. Cooperation can be vertical, i.e., an exchange of satisfiers between holons at different levels in a hierarchy, or it can be horizontal, i.e., an exchange of satisfiers between holons at the same or similar levels in a hierarchy. For a living holon to form, it is not necessary that every pair of component holons cooperate horizontally and exchange satisfiers with one another. However, they must cooperate vertically, either voluntarily or involuntarily, and exchange satisfiers with the control component or leader. This often takes the form of information flowing upwards and instructions flowing downwards.

Law B04: Human holons form a nested hierarchy. Human holons form a nested hierarchy. For example: at the lowest level there may be several individuals; at a higher level they may form an organisation; at a yet higher level several organisations may form a nation; and at the highest level several nations form humanity.

Law B05: Control components form a hierarchy. Because human holons form a hierarchy and every human holon has a control component, the control components of human holons also form a hierarchy.

Law B06: Leadership roles. Leadership roles, because of the benefits they convey, act as satisfiers. However, such roles are limited and cannot be filled by all. So, they generate competition.

C. General Laws of Interactions

Law C01: The range of interaction types. The range and types of horizontal interaction are the same at all levels. They are also the same as the range and types of vertical interaction. Thus, for example, the same range of interactions can be found between two individuals, between two organisations, and between an individual and an organisation.

Law C02: Isomorphism between ecological and social interactions. With the possible exception of redistribution, all human social interactions are the same as ecological ones. However, they are often broken down in more detail and given different names than those used in ecology.

Law C03: Isomorphism for the range of interactions. The range of interactions of all living holons comprising more than one individual is the same as that of a living holon comprising just one.

Law C04: Avoidance of contra-satisfiers. All living holons normally seek to avoid contra-satisfiers. The active acquisition of a contra-satisfier can take place, but this is rare and considered abnormal. For example, it is abnormal for one party to take a contra-satisfier from another. This is because a living holon affected by a contra-satisfier is less likely to survive and procreate than one not affected by it.

Law C05: Acquisition of satisfiers. All living holons seek to acquire satisfiers if their needs are not fully satisfied.

Law C06: Necessary interaction with the environment. All living holons are open systems that interact with their environment. They give satisfiers and contra-satisfiers to it, take satisfiers from it, have satisfiers and contra-satisfiers given to them by it, and have satisfiers taken from them by it. These processes are taken for granted in ecology, and so, have no formal name.

Law C07: Agency in the environment. For the environment to take a satisfier from a living holon an agent or agents must be acting.

Law C08: Satisfiers experienced by the source. If the source of a satisfier needs it but has no resilience in it, then taking the satisfier from it is equivalent to imposing a contra-satisfier on it. This situation is therefore symbolised y+X X-y. The same is true when there is no resilience in the environment, i.e., e+X X-e. Examples are parasitism, predation, and herbivory.

Law C09: Contra-satisfiers experienced by the source. If the source of a contra-satisfier suffers the same contra-satisfier, then taking the contra-satisfier from it is the same as giving a satisfier to it. This situation is symbolised y-X X+y. This is an alternative form of real altruism. However, it is abnormal to actively take a contra-satisfier from another party (Law C04).

Law C10: Perceptions of satisfiers and contra-satisfiers. It is the perception of a potential satisfier or contra-satisfier that determines the behaviour of a living holon, and not necessarily its actuality.

D. Laws of decision-making

Law D01: Most decisions have both benefits and disbenefits. That is, if implemented, they yield both satisfiers and contra-satisfiers. Rarely are they entirely beneficial.

Law D02: Inclusive fitness. Although living holons act primarily in their self-interest, they also act in the interest of their closest relatives, such as children, parents, and siblings. Less commonly, they act to protect more distant relatives such as cousins, aunts, and uncles. This is because they share some of the actor's genes or culture. The actor does, however, give the benefits a diminishing weight as the relatedness of the beneficiary to the actor decreases.

Law D03: A net benefit is necessary for voluntary interaction. No living holon will voluntarily interact with another unless there is believed to be a net benefit in doing so.

Law D04: The effect of frustration. The behaviour of a holon subject to frustration is unpredictable.

E. Laws of Power

Law E01: The effect of power 1. Where the two parties are relatively equal in power, it is abnormal for the one to give a contra-satisfier to the other if the latter is also a source of satisfiers. However, this changes when one party is more powerful than the other.

Law E02: The effect of power 2. Where the two parties are relatively equal in power, it is abnormal to give a satisfier to the other party if it is also a source of contra-satisfiers. However, this changes when one party is more powerful than the other.

Law E03: The trading of power. Type B or excess power can be traded with others to yield a net benefit. That is, some can be delegated to others in return for support that brings with it greater power. To persuade others to trade in this way, it is necessary to demonstrate power by overtly displaying wealth and control. In this way, a hierarchy forms that is based on type B power and the control of others.

F. Laws of similarity of satisfiers and contra-satisfiers

Law F01: All human holons have the same range of needs. These form a hierarchy with existence needs at the lowest level, relatedness needs at the next, and growth needs at the highest. All human holons prioritise their needs in that order.

Law F02: The effect of similarity of determinants of needs. The more similar the determinants of the needs of two living holons the more similar their needs. These determinants vary according to the type of need and type of holon, as described below.

Need	Determinant	
	In the individual holon	In larger holons
Growth	Genome/Culture/Function	Culture/Function
Relatedness	Genome/Culture/Function	Culture/Function
Existence	Genome	Function

***Table A1** - The determinants of the needs of individual people and larger human holons.*

Law F03: The effect of similarity of needs. The more similar the needs of two living holons the more similar the satisfiers and contra-satisfiers of those needs. Thus, for example, individual organisms within the same species seek to acquire the same existential satisfiers and avoid the same existential contra-satisfiers.

Law F04: The effect of functional differentiation 1. The more specialised the function of providing a satisfier or contra-satisfier, the fewer the sources of that satisfier or contra-satisfier.

Law F05: The effect of functional differentiation 2. The fewer the sources of a satisfier the more likely it is that two human holons with a common need will share the source of a satisfier.

Law F06: The effect of geographical proximity. Living holons tend to acquire their satisfiers from sources geographically close to them. Thus, the closer two holons are geographically, the more likely they are to share the source of a satisfier.

Law F07: The effect of cultural similarity. Living holons tend to acquire their satisfiers from sources with a similar culture. Thus, the closer two holons are culturally, the more likely they are to share the source of a satisfier.

Law F08: The likelihood of insufficient common satisfiers. The more likely it is that two living holons share the same source of a satisfier, the less likely it is that the satisfier will be sufficient for both.

G. Laws of Neutralism

Law G01: Effect of sufficient common satisfiers. If a satisfier is sufficient for all, then the parties who need it merely interact independently with the source, and the relationship between them is one of neutralism.

Law G02: Effect of avoidable common contra-satisfiers. If common contra-satisfiers do not exist or if it is possible for all parties to avoid them, then only insufficient fitness in the evolutionary sense will cause a party to fail to avoid them. The parties merely interact independently with the source to avoid the contra-satisfier, and the relationship between parties is one of neutralism. For example, we can all be careful to avoid accidents when crossing the road.

Law G03: The effects of population growth. A population grows until a satisfier needed by it becomes insufficient for all. The situation may also arise in which not all parties are able to avoid a contra-satisfier.

H. Laws of Positive Competition

Law H01: Effect of insufficient common satisfiers. For living holons who need the same satisfiers, if there is insufficient for all parties, then the relationship between them will initially be one of positive competition.

Law H02: Cause of unavoidable contra-satisfiers. If a contra-satisfier must necessarily have a victim, then the source of the contra-satisfier must have agency. For example, insectivorous birds must feed on some insects.

Law H03: Effect of unavoidable contra-satisfiers. If a contra-satisfier must have a victim, then the relationship between potential victims will initially be one of positive competition.

Law H04: The effects of insufficient satisfiers or a preponderance of contra-satisfiers. When a common satisfier becomes insufficient for two living holons, or a common contra-satisfier cannot be avoided by both, then the relationship between the parties is initially one of positive competition. (Law H01 & Law H03). They then can either:

a) where feasible, cooperate to gain greater mutual access to the satisfier or mutually avoid the contra-satisfier;
b) At any point during competition as it morphs into conflict, one party can, if possible, move to another geographical location (Law I02) or alter its function. In this way the satisfier may become sufficient for both or the contra-satisfier avoidable by both. In the social context, a change of function that results in a change of satisfiers or contra-satisfiers can be the equivalent of moving to another geographical location (Law I01); or
c) the two parties can continue to compete to acquire the satisfier or avoid the contra-satisfier. It is this that can lead to conflict.

Law H05: Effect of indirect competition to acquire satisfiers. Indirect competition to acquire satisfiers can result in some of the parties being unable to acquire a satisfier that has already been fully exploited by others.

Law H06: Effect of indirect competition to avoid contra-satisfiers. Indirect competition to avoid a contra-satisfier can result in some of the parties being unable to avoid it. Thus, for example, Z-x Z-y → x Z-y.

Law H07: Effect of indirect competition. If the acquisition of a satisfier or the avoidance of a contra-satisfier is necessary for existence or procreation, then indirect competition can cause one party to die or become extinct. Thus, for example, x>y z+X z+Y → z+X. The result is amensalism, a form of interaction in which one party, whilst carrying out its normal function, causes harm to or the expiry of another without any benefit to itself. The one cannot thrive or exist in the presence of the other.

Law H08: Factors affecting the transition from indirect competition to conflict. The more selfish a living holon and the stronger its belief about the threat posed by a competitor, the more likely it is to behave in a way that causes a contra-satisfier or threat to that competitor. Conversely, the more selfless a living holon and the weaker its belief in any threat posed by the other party, the less likely it is to behave in that way.

Law H09: Effect of positive competition to take satisfiers from an agent. If a third party has agency, then positive competition to take satisfiers from it can result in conflict between each party and the third party, i.e., z+X z+Y → Z-x X-z Z-y Y-z.

Law H10: Effect of positive competition to avoid contra-satisfiers from an agent. Positive competition to avoid contra-satisfiers from an agent can result in parties accepting a state of coercion, e.g., z>x z>y Z-x Z-y → z>x Z-x z>y X+z Z-y Y+z.

Law H11: **Effect of positive competition to receive satisfiers from an agent.** Positive competition to receive satisfiers controlled by a third party with agency can result in positive competition to give satisfiers to it in the hope of it reciprocating, i.e. Z+x Z+y → X+z Y+z

Law H12: Effect of positive competition to give satisfiers to an agent. Positive Competition to give satisfiers to a third party occurs in the hope of the third party reciprocating (Law H11). However, because the ability of the third party to provide satisfiers is limited, it can result in the competitor with greater power entering into a co-operative relationship with the third party and the other failing to do so, e.g., x>y X+z Y+z → X+z Z+x.

Law H13: Alliance. Alliances can form when there is positive or negative competition. The two competing parties can enter into cooperative arrangements with others in order to improve their likelihood of acquiring the relevant satisfier or avoiding the relevant contra-satisfier. The two alliances then become the two competing parties.

Law H14: Escalation of competition. If two competing parties are relatively evenly matched, then a feedback loop can occur in which both parties seek ever more alliances because to fail to do so would be to allow the other party to succeed. The effect is to broaden the competition and this can cause groups, nations, and even global society to become competitively divided.

I. Laws of migration and change of function

Law I01: Functional difference is equivalent to spatial distance. In human affairs, functional difference is equivalent to spatial distance.

Law I02: Migration. Positive competition can lead to conflict, and thus, harm to both parties (Law M01). So, it is notable that the parties will often attempt to avoid the latter. At any stage during escalation from positive competition to violent conflict, one party can migrate or change its function, and thus, alter the common satisfier or contra-satisfier competed over.

Law I03: Population growth and resource depletion. Population growth and resource depletion can cause migration, and thus, bring previously separated parties into contact.

J. Laws of cooperation

Law J01: Biological altruism can lead to cooperation. Altruistic acts inspire trust in the recipient, i.e., the belief that the altruist has a cooperative attitude, and so, facilitate cooperation between the parties.

Law J02: The failure of cooperation. Cooperation fails when the total effort required for the cooperative endeavour exceeds the total benefits gained. This is because some members of the cooperative enterprise must experience a net disbenefit, and so, will be unwilling to cooperate further.

Law J03: The control of others is an unsatisfiable need. The control of others is an unsatisfiable need, because, in practice there are always others with greater power. If an individual or larger holon prioritises its need to control others and pursues it without restraint, then this will consume endless resources. However, the resources that any holon can generate are finite. So, if vertical cooperation is attempted with such holons, then ultimately, some of the junior partners must face a situation in which the disbenefits outweigh the benefits. Their share of the satisfiers will fall below the threshold necessary to satisfy their needs and those of their dependents. So, any voluntary vertical cooperation will fail.

Law J04: Failure to cooperate. We can slip into conflict. People do not always behave logically and can irrationally compete when cooperation is the means to success. (Katz, Finestone & Paskevich, 2022).

Law J05: **Effect of reciprocal theft.** If an organism, group of organisms, or species needs a satisfier and does not have a surplus of it, then taking the satisfier from it is the same as giving a contra-satisfier to it, i.e., x+Y Y-x or y+X Y-x (Law C08). If this is true of both parties, reciprocal theft, or x+Y y+X, becomes conflict or X-y Y-x. However, if both parties do not need the satisfier or have a surplus, reciprocal theft remains just that.

K. Laws of spite

Law K01: Provision of misinformation to acquire satisfiers or avoid contra-satisfiers from an agent. Indirect competition to acquire satisfiers from an agent can result in the parties providing the controller of the satisfier or contra-satisfier with misinformation, either by creating it or propagating it. The greater the likely impact of the satisfier or contra-satisfier on them, the greater the probability that they will provide such misinformation.

Law K02: Spite to acquire a satisfier 1. Spite occurs when there is a scarce satisfier in the environment or controlled by a third party that is insufficient for all. If one holon has a negative interaction style and appears to be losing the competition, it can commit an act of indirect spite. This involves preventing the source of the satisfier from delivering it to the other party. For example, by polluting a well or persuading those capable of giving a promotion that the other party is unsuitable. Normally, these are covert actions in the hope that the other party will not discover them.

Law K03: Spite to acquire a satisfier 2. An indirect spiteful act can occur if the other party has a satisfier that the spiteful actor also wants. The spiteful actor influences the source to change the beneficiary from the competitor to itself, i.e., Z+y → X-(Zoy)y.

Law K04: Spite to avoid a contra-satisfier 1. Spite occurs when there is a contra-satisfier in the environment or controlled by a third party that cannot be avoided by all. If one party believes that it is losing in positive competition to avoid the contra-satisfier then it will attempt to prevent the other from avoiding it by influencing the environment or third party.

Law K05: Spite to avoid a contra-satisfier 2. An indirect spiteful act can occur if the other party is avoiding a contra-satisfier that the spiteful actor also wants. The spiteful actor influences the source to change the victim from itself to the competitor, i.e., Zoy → X-(Z-y)y.

Law K06: Effect of spite. Others who are not the target of spite may regard it as a contra-satisfier or threat to themselves, and may cooperate to avoid or eliminate it.

L. Laws of negative competition

Law L01: Negative competition to receive a satisfier. Negative competition to receive a satisfier occurs when there is a scarce satisfier in the environment, or held by a third party, that is insufficient for all. If the spiteful actor fails to act covertly, or does not quickly prevail, or if the spiteful actor is believed by the target to have engaged in spiteful acts, then the target may, but does not necessarily, reciprocate. This results in both parties doing their best to influence the environment or third party to prevent the other from receiving the satisfier so that it is available to them instead.

Law L02: Negative competition to avoid an unavoidable contra-satisfier. Unavoidable contra-satisfiers are imposed by an agent, i.e., there is a threat from a third party (Law H02). Negative competition occurs when a contra-satisfier controlled by a third party cannot be avoided by all. If one party is believed by the other to have engaged in spiteful acts, then the other will often reciprocate. This results in both parties doing their best to influence the third party to impose the contra-satisfier on the other so that they can avoid it themselves.

M. Laws of conflict

Law M01: Effect of negative competition. Negative competition can escalate into conflict in which the parties directly impose contra-satisfiers on one another.

Law M02: Covert conflict. It is possible for conflict initially to be covertly one sided. For example, bands of chimpanzees engage in wars for territory, but begin with covert raids in which individuals from the other group are murdered.

Law M03: Recognition of direct spite. Once one party physically imposes a contra-satisfier on another, and this is recognised by the latter, then any threat perceived by the latter becomes real. The latter can, but does not necessarily, reciprocate and the situation becomes one of conflict.

Law M04: Conflict can escalate by a feedback loop. Unless there are controls, external or otherwise, a feedback process will occur in which the contra-satisfiers that the two parties impose on one another escalate until the conflict becomes violent. This escalation ultimately leads to the most powerful party prevailing and the losing party can be killed or become extinct, i.e., x>y X-y Y-x → X. The interaction is then one of predation, or parasitism.

N. Laws of coercion

Law N01: From voluntary to involuntary vertical cooperation or coercion. Because an unsatisfiable need for the control of others leads to the failure of voluntary vertical cooperation (Law J03), it must ultimately lead to attempts to acquire their involuntary vertical cooperation or to coerce them.

Law N02: Frustration can lead to involuntary vertical cooperation or coercion. If the interaction style of a subordinate leader or a child holon does not accord with that of a senior leader or holon then the latter may seek the involuntary vertical cooperation of the former or attempt to coerce them.

Law N03: Acceptance of involuntary vertical cooperation or coercion. Without resistance, involuntary vertical cooperation or coercion becomes an accepted norm.

Law N04: Becoming trapped by involuntary vertical cooperation or coercion. Once a holon forces involuntary vertical cooperation or engages in coercion, it cannot give up its power without facing retribution.

O. Laws of resistance

Law O01: From Coercion to voluntary vertical cooperation or conflict. With resistance, attempts at coercion can fail, and the relationship remains one of voluntary vertical cooperation. Alternatively, however, conflict can result.

Law O02: Effects of resistance. Resistance by the victim ultimately results in the aggressor either succeeding, i.e., y>x X-y x+Y → x+Y, or failing to take the satisfier from it, i.e., x>y X-y x+Y → xoy.

P. Laws of indirect malefaction, predation, parasitism & herbivory

Law P01: Cause of indirect malefaction. Indirect malefaction has no apparent cause and is merely a consequence of the existence and normal activities of an organism.

Law P02: Herbivory. A herbivore is an animal that consumes plants. So, it is impossible for individuals or groups from the same species to have a herbivorous relationship.

Law P03: Effect of indirect malefaction, predation, parasitism, and herbivory. If a contra-satisfier experienced as a result of indirect malefaction, parasitism, predation, or herbivory, affects the existence or procreation of the host or recipient, then the latter will expire or die. In the case of indirect malefaction this is symbolised X-e E-y → X-e, in the case of parasitism it is X-y y+X → X, and in the case of predation or herbivory it is x>y X-y y+X → X.

Law P04: Effect of the expiry of a parasite's host. All parasites take satisfiers from their host. If a parasite has no host or its host has expired, then it will die.

Q. Laws of evolution

Law Q01: Only living things and their artifacts evolve. Only living things and their artifacts have a design that can alter. Thus, evolution applies only to living things and the artifacts that they create. Only living organisms and not, for the present at least, their artifacts are capable of self-assembly from their design. In the latter case, an external agent is still needed to carry out the assembly.

Law Q02: What evolves is the subject's design. What evolves is not the physical manifestation of the subject but rather its design, i.e., the information that determines how it is formed. In the case of a living organism, this design is its genome or genetic constitution. In the case of society, the equivalent of the genome is its culture, that is, its values, norms, beliefs, knowledge, and symbols, all of which are, of course, information. In the case of an artifact, it is literally the design of the artifact as held, for example, in the minds of the organisms, on paper, or on a computer.

Law Q03: Cultural evolution can precede biological evolution. In humans, cultural evolution is thought to be a precursor to biological evolution. So, if geographical separation is possible in the long term, then biological speciation will eventually occur.

Law Q04: Genomes and cultures are subject to "random" mutation. Random mutation in living organisms is due to changes to the genome, caused for example by duplication errors, radiation, or viruses. Many of these changes are harmful, a few are neutral, and even fewer beneficial. Human society is a living thing, and it too is subject to random changes in its equivalent of the genome, that is, its culture. These random mutations take the form of new theories, opinions, attitudes, lies, etc.

Law Q05: Phenotypes and societies are subject to natural selection. Natural selection operates on the phenotype of an organism. Under selective pressures from the environment organisms with harmful mutations often expire or fail to reproduce, whilst those with beneficial mutations tend to propagate. Natural selection also operates on society. The more successful a society is in satisfying the needs of its members the more likely that society is to survive and propagate.

Law Q06: The effect of vested interests on cultural evolution. In principle, through the propagation of information, cultural mutations that are clearly true to reality and of benefit to society should be selected for; others that are neutral should persist, perhaps to come to the fore if the environment changes; and those that are clearly harmful should expire. However, vested interests can influence the propagation of information. This occurred before the advent of the internet when, for example, the Catholic Church supressed scientific discoveries. More recently, commercial, and political interests have promoted information on the internet that supports their objectives and supresses that which does not. To some extent this alters the direction of cultural evolution by accelerating the rate of propagation in some directions, e.g., consumerism, whilst slowing it in others, e.g., environmentalism.

Law Q07: Changes in the environment. The environment, by changing, provides new satisfiers, i.e., E+x, or contra-satisfiers, i.e., E-x. Living holons that are best fitted to exploiting a new satisfier or to avoiding a new contra-satisfier are more likely to survive and procreate than those least well fitted. This acts as a driver of both biological and cultural evolution.

Law Q08: Evolution under the effect of a contra-satisfier. When a contra-satisfier that impacts on a living holon's ability to survive and procreate is applied to a population of living holons, then those most able to avoid it are more likely to survive and procreate than those least able. This ability to avoid the contra-satisfier stems from the design of the holon, i.e., its genome or culture. Thus, genetic or cultural attributes that enable avoidance of the contra-satisfier are selected for, and the proportion of those better able to avoid it steadily increases. Advantageous genes or ideas will propagate through the population and disadvantageous ones will expire.

Law Q09: Evolution under the effect of shortages of satisfiers. When a shortage of a satisfier that impacts on a living holon's ability to survive and procreate is applied to a population, then those best able to acquire the satisfier are more likely to survive and procreate than those least able. Again, through natural selection, the proportion of those better able to acquire the satisfier steadily increases.

Law Q10: Competitive co-evolution. It is possible for two populations of living holons to compete to acquire the same satisfier or avoid the same contra-satisfier. In this case, both populations evolve to become ever more capable. Ultimately, one may succeed and the other may expire. But until that time, neither fully succeeds because of the evolution of the other, and ongoing evolution causes the two to become ever more specialised. For example, male stags become ever stronger. Armies become ever more skillful.

Law Q11: Cooperative co-evolution. Cooperation comprises the exchange of satisfiers between two parties. If the two parties have different functions, and the receipt of a satisfier from the other party improves their ability to survive and procreate, then cooperative co-evolution will occur. Genetic or cultural traits that better enable one party to acquire the satisfier from the other will propagate through the population. Genetic or cultural traits that enable one party to deliver the satisfier to the other more efficiently, i.e., using fewer resources, will also propagate through the population. Over time, this can result in both parties becoming highly specialised and dependent on one another. This processis true of both horizontal and vertical cooperation.

Law Q12: Complex evolution. Most decisions have both benefits and disbenefits. That is, if implemented, they yield both satisfiers and contra-satisfiers. Rarely are they entirely beneficial (Law D01). If an action that yields both a benefit and a disbenefit becomes established, and if they affect the ability of the holon or holons that experience them to survive and procreate, then they will become evolutionary drivers for that holon or those holons. If the benefit and disbenefit are both experienced by the actor, then both become evolutionary drivers for that actor. If they apply to different holons, then they become individual evolutionary drivers for those holons. These drivers will cause the benefit to be acquired ever more efficiently and the disbenefit to be avoided ever more effectively. Thus, the holon or holons will become ever more specialised.

Law Q13: Speciation. In living organisms, evolution leads to speciation. Successful mutations accumulate on different lines, and these lines become increasingly different. Initially, they form sub-species that can interbreed, but eventually they become entirely separate species that cannot. The same is true of culture, initially cultural mutations lead to sub-cultures which operate largely within the main one. Interaction between the sub-culture and main culture slows the rate of divergence. However, as mutations accumulate, it becomes increasingly difficult for the sub-culture to operate within the main one, and a separation can occur. An example is the migration of religious groups from Europe to the USA.

Law Q14 (see component laws): The Potential evolution of biological altruism. Biological altruism creates the following feedback loops:

a) The more people there are who behave altruistically, i.e., X+y, the more beneficiaries there are (**Law Q14a**), the more society socializes its members to value altruism (**Law Q14b**), and so, the more people there are who behave altruistically (**Law Q14c**).
b) The more people there are who behave altruistically, the greater the altruism of the culture of which they are a part (**Law Q14d**), the greater the safety this culture offers against misfortune, the greater the satisfaction of the human need for security (**Law Q14e**), the greater the reduction in the cost of behaving altruistically (**Law Q14f**), and so, the greater the number of people who behave altruistically (**Law Q14g**).
c) There will of course be free riders, i.e., those who accept the benefits of altruism but do not behave altruistically themselves (**Law Q14h**). However, as beneficiaries, they will encourage altruism (**Law Q14i**). Societies also impose penalties for free-riding, and so, free-riders disguise their behaviour (**Law Q14j**). Thus, a negative feedback loop that diminishes altruism is avoided.

Law Q15: Parasites can evolve. Because a parasite that does not cause its host to expire is more likely to survive and procreate, parasites evolve so that they do not cause their host to expire.

Law Q16: Parasitism, predation, or herbivory can result in adaptation. A parasite, predator or herbivore can adapt to provide benefits and reduce disbenefits to its host, and thus, a co-operative relationship can evolve.

Law Q17: Evolution of redistribution. A process of cultural evolution centered on redistribution is in progress. The driver is indirect competition between nations, and the process comprises: innovation, trial and error, propagation of the most successful methods, and expiry of the least successful.

16. Appendix B – Diagrams

Diagrams can help us to understand complex sets of relationships by enabling us to visualize them. There are two types of diagrams in social systems theory. Both are causal.

A. Holon interaction diagrams

One, a holon interaction diagram, shows the interactions between holons at any point in time and how changes to the outputs of one holon affect the inputs of the other.

An example of a holon interaction diagram is given below. Most interactions are two-way. That is, satisfiers and contra-satisfiers are traded between the two interacting organisations or individuals.

Figure B1 *- A causal diagram showing a typical cooperative trading relationship between two holons. The arrows show the direction of transfer. The text in the central boxes specifies the actor, the status of what is being transferred, nature of what is being transferred, and whether it is a satisfier or contra-satisfier for the recipient. The ticks or checks at the top show that if it is given by the holon of the relevant colour; then it is received by the holon of that relevant colour. The crosses show that if it is not given then it is not received. Other symbols can be used here to indicate variable or probabilistic relationships. The relevant needs and their status can also be written in the holon boxes.*

In principle at least, such diagrams can be translated into a series of causal equations that can be combined and manipulated according to the rules of logic.

B. Interaction dynamics diagrams

The second type of diagram, an interaction dynamics diagram, shows how each type of interaction, irrespective of the holons involved, can change with time.

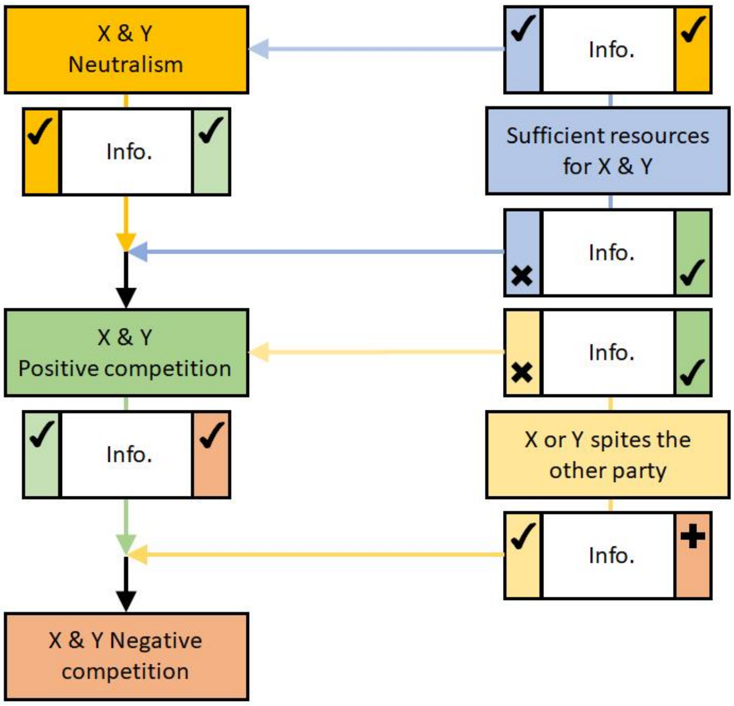
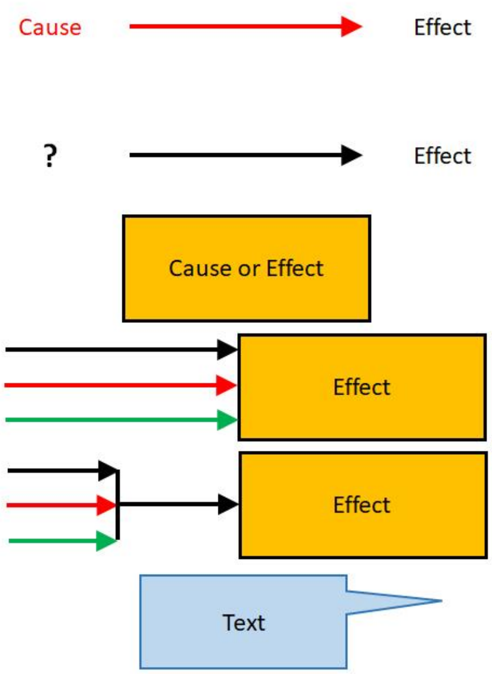


Figure B2 *– A typical interaction dynamics diagram.*

C. Causal diagram conventions

Both types of diagram use the same convention as follows.



The cause is a system that produces an output. The effect accepts this output as an input. The arrow shows the direction of transfer of the output and can be coloured to match the cause.

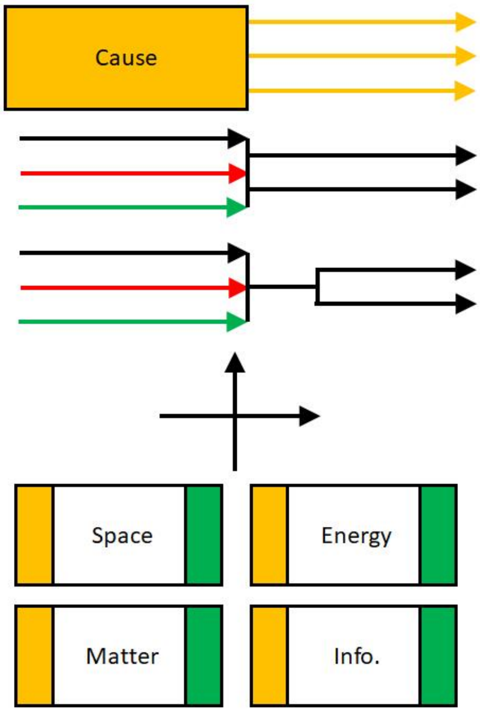
The question mark indicates an unknown or unspecified cause.

The box represents a cause or effect and can be coloured for clarity if there are several. The text describes the cause or effect and its states.

Three causes each of which is sufficient for the effect.

Three causes each of which is necessary but only together sufficient for the effect.

Comment box.



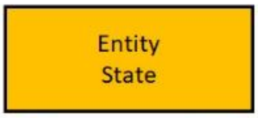
One cause with three outputs.

Three causes each of which is sufficient for two effects.

Three causes each of which is necessary but only together sufficient for two effects.

Causal arrows that cross one another but are not connected.

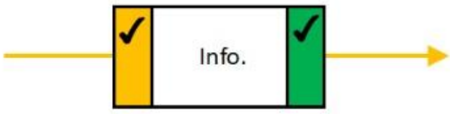
The coloured box on the left always refers to the cause; the coloured box on the right to the effect. The text refers to what is transferred from the cause to the effect. The general classes of what can be transferred are space, energy, matter and information, but a more specific description can be given.



A logical cause or effect. The state of the entity can be true or false.

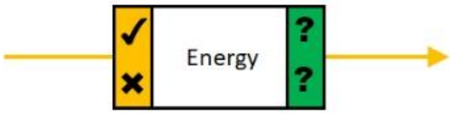
The cause and effect are both logical. If the cause is true, then the effect is true. If the cause is false, then the effect is false.

The cause and effect are both logical. If the cause is true this increases the probability of the effect being true. If the cause is false it decreases the probability of the latter.

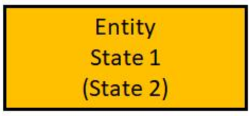


The cause and effect are both logical. If the cause is true, then the effect is true. But if the cause is false, then the effect is not necessarily false.

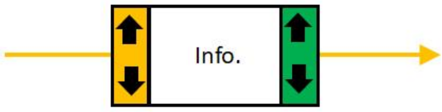
The cause and effect are both logical. If the cause is true, then the effect is false. But if the cause is false, then the effect is not necessarily true.



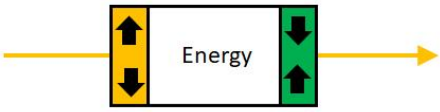
The cause is logical but its influence on the effect is not known.



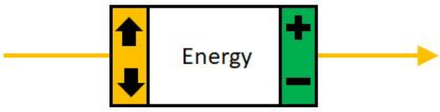
A variable cause or effect. The state of the entity lies between a maximum of state 1 and a minimum of state 2.



The cause and effect are both variable. The state of the effect correlates with the state of the cause.



The cause and effect are both variable. The state of the effect inversely correlates with the state of the cause.



The cause is variable and the effect logical. The probability of the effect being in state 1 correlates with the magnitude of the cause.

The cause is variable and the effect logical. The probability of the effect being in state 1 inversely correlates with the magnitude of the cause.

17. Appendix C – Glossary

Agency. The ability of an organism or group of organisms to make its own decisions and act independently.

Alliance. An alliance is essentially a direct cooperative arrangement between two or more parties.

Amensalism. An ecological interaction in which one party is harmed, whilst the benefits or harms to the other are negligible.

Antibiosis. An ecological interaction in which in which at least one party is harmed.

Behavioural predispositions. These are states of mind which do not necessarily lead to immediate action, but which prepare us to act when the opportunity to satisfy a need arises.

Benefit. Any increase in the level of satisfaction of a living holon's needs.

Bottom-up process. A process in which followers choose a leader thought to be best qualified to co-ordinate their activities.

Commensalism. An ecological interaction in which one party benefits, whilst the benefits or harms to the other are negligible.

Competition. An interaction in which the parties seek to acquire satisfiers or avoid contra-satisfiers at the expense of the other.

Conflict. An interaction in which both parties harm one another.

Contra-satisfier. Any external thing that reduces the level of satisfaction of a living holon's needs.

Control component. A control component co-ordinates the activities of the other components of a holon.

Cultural Speciation. The tendency for more than one separate culture to evolve from a single one.

Culture. Culture is information. It comprises values, norms, beliefs, knowledge, and symbols and is held in the minds of individuals. Values are those things that we hold good or bad; norms are socially desirable, acceptable, or unacceptable forms of behaviour; and symbols are those things, such as rituals, modes of dress, etc., that indicate our membership of a group.

Disbenefit. Any decrease in the level of satisfaction of a living holon's needs.

Direct interaction. An interaction in which a satisfier or contra-satisfier that is controlled by one of the parties and is given to or taken by another.

Emergent properties. These are properties held by systems which are not held by their component parts.

Eusocial species. Species that live in cooperative groups.

Fractal. A fractal is a system with similar properties at all scales.

Frustration. Frustration occurs when the culture of a holon is influenced by two or more other holons and the influences are contradictory. The original holon is then uncertain which culture to adopt.

Function. The function of a living holon is its output of satisfiers and contra-satisfiers.

Functional differentiation. The tendency for functions to become more specialised with time and for there to be fewer holons with each function.

Generator. The rule that creates a fractal.

Genome. The genome of an organism comprises all genetic information held by the organism and can be regarded as its design.

Hierarchy of needs. The order in which we usually prioritise our needs.

Horizontal Cooperation. The exchange or trade of satisfiers between two living holons at the same or similar levels in a hierarchy.

Horizontal interaction. An interaction between human holons at the same level in a hierarchy.

Human holon. A human holon is any individual, group of people or group of groups who work together with a common purpose.

Indirect interaction. An interaction between one living holon and its environment that affects another living holon.

Interspecific interactions. Interactions between species.

Intraspecific interactions. Interactions within a species.

Isomorphism. A similarity of structure that can be found in different types of entity or situation.

Living holon. Any living organism, group of organisms, or group of groups that work together with a common purpose.

Money. Money is information and property that acts as a satisfier to the recipient and as a contra-satisfier to the giver.

Mutualism. An ecological interaction in which both parties benefit.

Needs. Needs are internal functions or states that can be satisfied by interaction with the environment.

Net Benefit. Any overall increase in the level of satisfaction of living holons' needs after taking into account all satisfiers and contra-satisfiers for the needs of all parties affected and applying relative weights to them.

Net disbenefit. Any overall decrease in the level of satisfaction of living holons' needs after taking into account all satisfiers and contra-satisfiers for the needs of all parties affected and applying relative weights to them.

Neutralism. An ecological interaction in which neither party benefits and neither is harmed.

Phenotype. An organism's physical manifestation

Power. The measure of a living holon's control of satisfiers and contra-satisfiers for itself and others.

Property. If we control a source of satisfiers or contra-satisfiers, then that source is regarded as property.

Satisfier. Any external thing that increases the level of satisfaction of a living holon's needs.

Simple interaction. An interaction between one living holon and its environment that does not affect another.

Socialisation. The establishment of values, norms, and beliefs in an individual or organisation. This is brought about by a process of reward from members of our society if we comply, and punishment if we do not.

Speciation. The tendency for more than one separate species to evolve from a single original.

Sub-culture. A culture that has differences from its parent culture but not to the extent that its members are unable to successfully interact with it.

Sub-species. A group of organisms that have genetic differences from a parent species but not to the extent that they are unable to successfully interbreed with it.

Symbiosis. An ecological interaction in which both parties benefit.

Top-down process. A process in which leaders select the followers they believe best suited to a subordinate role.

Type A Power. Power less than or equal to that needed by a human holon to satisfy its own needs and those of its dependents. In the absence of type A power a human holon is in a state of powerlessness and, in its presence, a state of freedom or independence.

Type B Power. Power greater than that needed to satisfy the needs of a human holon and its dependents. It comprises the control of satisfiers and contra-satisfiers for others and can be used to control them.

Vertical Cooperation. The exchange or trade of satisfiers between two living holons at different levels in a hierarchy.

Vertical interaction. An interaction between human holons at different levels in a hierarchy.

18. Appendix D - Notes

[1] The term "synergic" is given as a quote because, if taken literally, it would mean several satisfiers working together to satisfy a need rather than the definition given.

19. Appendix E - References

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C https://sciencing.com/coevolution-definition-types-examples-13719185.html

D https://www.smithsonianmag.com/science-nature/when-it-comes-waging-war-ants-humans-have-lot-common-180972169/

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I https://www.frontiersin.org/articles/10.3389/fevo.2022.991714/full

J https://www.worldatlas.com/animals/10-examples-of-commensalism-in-nature.html

K https://plato.stanford.edu/entries/altruism-biological/

L https://pdx.pressbooks.pub/humanrelations/chapter/cooperation/

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Q https://www.worldvaluessurvey.org/

